Table 2 Storage capacity of tanks

Sr	Group	Bitumen (m^3)	White Products (m^3)	Jet fuel (m^3)	LPG (m^3)	HFO(m^3)
Present plan						
1.	3 × 7000 m^3 tanks for bitumen	21000				
2.	3 × 12,000 m^3 tanks for gasoil/gasoline 2 × 5,000 m^3 tanks for gasoil/gasoline		36,000 10,000			
3.	3 × 7000 m^3 tanks for Jet fuel			21,000		
	Total	21,000	46,000	21,000		
	Grand total: 88,000 m^3					
Future plan						
1.	1 × 10,000 m^3 for HFO					10,000
2.	3 × 12,000 m^3 for gasoil/gasoline		36,000			
3.	1 x 7,000 m^3 for jet fuel			7,000		
4.	LPG				20,000	
	Total		36,000	7,000	20,000	10,000
	Grand total: 73,000 m^3					

In terms of storage capacity, there will have different types of tank: 12,000 m^3 tank (Dia. 28 m × 17 mH), 7,000 m^3 tank (Dia. 23 m × 17 m and Dia. 23 m x 18 m H and), 5,000m^3tank (Dia. 21 m × 17 mH).All the tanks for white products will have internal floating roof and be interchangeable. All the jet fuel tanks are designed with internal floating suction line.

Primary construction works include land levelling, land filling and surfacing, temporary jetties as required, site camps, drainage, foundation testing, etc. The landfill is approximately 3-meter high. Material for the backfilling is sand dredged from the MPA approved sites Yangon River.

As mentioned early, an oil jetty with a berth is designed to receive from partially laden MRs or fully laden MRs after dredging and small river barges. Berth configuration shall be in accordance with the recommendation of BS 6349 and OCIMF guidelines. The configuration shall be capable of safe mooring and loading of two barges of 1000 DWT up to 5,000 DWT simultaneously with the required clearings between the vessels and no crossing of mooring lines. The berth structure includes fenders, bollards, ladders rubbing strips and safety handrails. The project has to dredge the river in front of the Plot No 3 to have a draft of 9 m to 10 m.

The access trestle shall consist of the following main items: roadway; pipe rack including piping; lighting; and safety provision including edge protection; hand railing; safety ladders; etc. The roadway and pipe rack will be spanned between bents comprising concrete or steel crossheads supported by concrete or steel piles.

The roadway is designed for travelling and operating of 5-tons mobile crane and travelling of a normal road going pick-up truck. It will have a cross fall of 1:50 and be free draining, discharging rain water directly into the river. The roadway shall have a minimum clear width between kerbs of 5.0 m and sufficient vertical clearance (headroom) for the passage of a 5-ton mobile crane and a normal road going pick-up truck. It shall comprise a concrete deck supported by steel or concrete beams spanning between the access trestle bents.

A vertical restraint system will be provided on both sides of the roadway. The restraint system shall have a containment level in accordance with BS EN 1317-2. The deck of the roadway shall be wide enough to ensure that wheels of errant vehicles do not leave

the deck at full deflection of the restraint system. Equipment and structures adjacent to the roadway shall be located outside the working width of the restraint system.

Safety ladders will be provided in accordance with international safety requirements. They shall be located at convenient bents. Gaps in the edge protection at the top of the safety ladders shall be closed by detachable chains.

The proposed project is designed to install the holding down system to the positions and levels as required for the pipelines, which are:

- 3 × 10″ pipelines for white products (to see going vessel and both barge berths);
- 1 × 10″ pipeline for bitumen (to see going vessel and one barge berth);
- 1 × 10″ future pipeline for LPG (to see going vessel and both barge berths);
- 1 × 10″ future (spare) pipeline;
- 1 × 10″ pipeline for firefighting water system;
- 1 × 4″ future vapour return pipeline for LPG;
- 1 × 2″ line for potable water:
- 1 × 2″ instrument air pipeline.

Also minimally one electrical duct (or tray), and one instrumentation duct (or tray) of 800 mm wide and 300 mm high are to be provided.

The piled quay consists of continuous concrete deck or composite steel and concrete deck structure supported by steel or concrete piles. The pile length has been based on a typical piled quay with vertical and raking Concrete SPUN piles in a regular 5 m by 5 m grid. The estimated pile lengths are: vertical piles: D 800 mm, 35-40 m (working load: 100-150 tons) and raking piles: D 800 mm, 45-50 m (working load: 300-350 tons). Seagoing vessels and river barges are expected to moor at the quay. At any time the quay shall be capable of receiving either a single sea going vessel or 2 river barges simultaneously. The following range of design vessels shall be capable of transporting all products.

- The Seagoing Vessels Berth shall be designed as a minimum to accommodate design vessels ranging from 7,000 DWT to 50,000 DWT. The full range of design vessels shall be capable of transporting all products.

- The River Barges berths shall be designed as a minimum to accommodate design barges ranging from 1,000 DWT up to 5,000 DWT. The full range of design vessels shall be capable of transporting all products.

The loading area of sea going vessels will be located at the middle section of the piled quay. The loading area for sea going vessels shall allow for the following marine loading arms and hose connections:

- 1 × 10″ Loading Arm for White products;
- 1 × 10″ Loading Arm for Jet Fuel;
- 1 × 10″ Loading Arm for Gasoline;
- 1 × 10″ Hose Connection for Bitumen;
- 1 × 10″ Future Loading Arm for LPG.

The loading area for river barges will be located at either ends of the piled quay. These loading areas at the piled quay shall allow for the following marine loading arms and hose connections:

North Barge Berth:

- 2 × 10″ Hose Connection for White products;
- 1 × 10″ Hose Connection for Bitumen;
- 1 × 10″ Future Hose Connection for Jet Fuel;
- 1 × Hose Connecting Crane with a minimal lifting capacity of 1 Ton or Gantry Frame Hose Structure.

South Berge Berth:

- 2 × 10″ Hose Connection for White products;
- 1 × 10″ Hose Connection for Bitumen;
- 1 × 10″ Future Hose Connection for Jet Fuel
- 1 × Hose Connecting Crane with a minimal lifting capacity of 1 Ton or Gantry Frame Hose Structure.

The following operational equipment and facilities shall be provided or accommodated on the piled quay:

- Pipe work, manifolds and valves on supports as necessary between the pipe rack and marine loading arms;
- The differential movement between the quay and the adjacent structures supporting pipe work shall be consistent with the pipe work deflection limitations specified;
- The platform shall be free draining with falls of at least 1%;
- Bollards with a clear working area of 1.5 m to the side and rear. The edge of the platform shall be protected against rope damage 0.5 m beyond the maximum operational range of the bollard;
- Fendering; appropriate for the range of design vessels over the full range of tidal levels;
- 1 T Hose Connecting Crane or Gantry Frame Hose Structure;
- Fire Water monitor towers (by Onshore Contractor);
- Operational equipment including slops tanks, pumps, etc (by Onshore Contractor);
- Turning area at end of quay for Mobile Crane with a minimal lifting capacity of 5 Ton and Control truck;
- Control Booth;
- Area lighting.

The mooring dolphins consist of a rigid reinforced concrete deck supported by concrete or steel piles. The Mooring Dolphins are required to accommodate the mooring lines for the range of vessels that will use the berth.

Each of the dolphins will be arranged to accommodate the following features:

- Bollards with a clear working area of 1.5 m to the rear and sides;
- Area lighting;
- Walkway seating
- Safety provisions including edge protection, handrails, lifebuoys, etc;
- Falls of 1:50 to the deck surface to prevent ponding and drain water directly into the sea;
- Ladders protected by fenders to the rear of the mooring dolphin structures to allow small boats to tie up alongside.

The walkway shall take the form of lightweight steel trusses or standard steel beams. The deck shall be open mesh flooring. Galvanized tubular steel handrails shall be provided on both sides of the walkway.

The walkways will have a minimum clear width of 1200 mm, measured from any equipment mounted inside the edge protection.Pipes and electrical cable trays running along the walkways shall be inside the edge protection and above the floor level to enable safe installation and maintenance.The maximum gradient of a walkway shall be 10%. Where this would be exceeded, stairs are to be provided at the end of the walkway. The stair shall have the same clear width as the walkway and minimum going of 250 mm. the stairs may be on the walkway structure of the adjacent structure provided they are not obstructing any operational requirements.Area lighting is required for all walkways. This may be provided by light fittings on adjacent structures. Where walkways from part of the emergency escape route to a place of safety, emergency lighting is required.

Fendering is fundamental to the safe operation of the berths. The Contractor shall ensure that fender systems are procured and installed which enable safe use of the berths and meet all the functional requirements for quay operations.

The fendering system shall allow for safe berthing of all vessels expected to use the berths.Berthing energy shall be calculated in accordance with the PIANC guidelines.

The rated berthing energies of the fender units shall be reduced by a factor recommended by the supplier but not less than 10%.A positional tolerance as per the recommendations of EAU2004 will be taken into consideration when assessing the berthing operations. Sufficient fenders must be provided to comply with the recommendations of BS6349 and OCIMF Guidelines and prevent vessel impact with the structure.Berthing angles between 0° and 6°shall be considered for vessels above 20,000 DWT and berthing Angles between 0° and 10° for vessels below 20,000 DWT.Berthing velocities shall be based on the appropriate curve from the PIANC Guidelines but shall not be taken as less than 0.1 m/s.The distance from the end of the vessel to the contact point shall be determined from the fender positions relating to the berthing target but shall not be less than 25% of the vessel length between perpendiculars. The factor of safety shall be those stated in the PIANC Guidelines.The fenders will be capable of resisting the design wind force on the vessel distributed over the fenders against the flat side of the vessel with a factor of safety of 1.5 m buckling fenders can resist this load with a factor of safety of 1.5 m their buckling load.

In accordance with the appropriate codes and standards the mooring arrangement and line forces will be determined.The mooring configuration shall consider vessel manifolds to be central to the appropriate marine loading arm of hose connection location. An appropriate allowance for the offset between the centre of the vessel and the centre of its manifold group shall be justified.The mooring arrangement shall be in

accordance with OCIMF guidelines. Computer analysis using OPTIMOOR or similar shall be used to verify the loads and vessel movements form the proposed arrangements. Permissible movements shall be checked with the proposed mooring arrangement.Line sizes shall be in accordance with BS 6349 and OCIMF guidelines. Maximum loads in any one line shall be 55% of the minimum breaking load.

One common firefighting system will be installed according to NFPA codes. Diesel firefighting pumps, jockey pump, portable extinguishers and deluge systems to tanks, truck loading bays and pump stations will be installed. 1 × 4,000 m^3 water tank will be part of the firefighting system (exact size to be confirmed according to NFPA requirements). The system will be common to serve the white product facilities, the bitumen facilities and the future LPG plant. A dedicated firefighting system for the jetty will be also foreseen in accordance with ISGOTT requirements. Fire hydrants, fire cabinet and lifebuoys will be also provided at no more than 80 metres along the roadway. They will be arranged at uniform centres to suit the bent spacing with safety equipment. Manual call points will be installed throughout the terminals and smoke detectors in the buildings.

Substation building (350 m^2) will accommodate the transformers LV switchboards MCC_s for each terminal. Backup generator (100% of the terminal operation needs) will be also included in the design to ensure immediate readiness. Small size generators for lighting, building needs, etc will be also included in the design. Lightening arrestor will be installed as per international norms standards and guidelines.

The bitumen in the storage tanks will have internal heating coils with hot oil. For the receiving pipeline and piping inside the Terminal, the heating system for the bitumen facilities will be hot oil traced.The total construction and operation costs (including reliability of supply) are considered in the selection of heating system for the pipeline. Internal tank heating coils shall be designed to ensure bitumen's uniform temperature when heated. The design of the heating system (hot oil system for tanks) must meet any of the following conditions. Tanks heated and maintained to working of 150 °C, each tank shall be feasible to be heated from 100 °C to 150 °C in approximate 24 hours, the pipeline shall be heated to 150 °C from ambient temperature in approximate 48 hours, pipeline to be hot oil traced, and 100% back up boiler shall be included in the design. Fuel tank for boiler needs to be good for 5 days requirement.Either Natural Gas/LPG or Gasoil/Medium Fuel Oil will be used for the dual burner of hot oil boiler. Appropriate circulation pumps and control valves will be also included.

Drainage, storm water and oily water treatment will be included in the design for the white products terminal. It would be capable of treating three types of sewage: live waste, oily sewage and fire fighting sewage. Drainage, storm water, and oil water treatment will be foreseen for bitumen and future LPG facility. Outlet connection is to be verified in detailed design phase.

Required fresh water will be taken from the domestic water line or from Zamani Inn Dam located at about 5 km. The water supply system consists of water treatment plant for drinking and domestic purposes, construction of 1 × 4,000 m^3 water tank, and the fire fighting and operational water supply system. Installation of deep tube well is included in the project. Water for the 4,000 m3 firewater tank will come from the deep tube well.

According to the project design, ventilation and air-conditioning facilities, CCTV system, communication and information system including phone system, radio walkie-talkie system, firefighting monitor system, safety and guard system and information network system will be installed.

Patrol and access roads will be included in the design. An access road from the main road to the terminal shall be also constructed. Approximate length will be 750 m band the width shall be 10 m. This road shall be within the project premises (200 m × 700 m).

3.7 Construction Methods and Materials Used

All vertical cylindrical storage tanks are of steel structure design. It is obvious that welding, metal cutting, threading, rolling and grinding works in the processes of mechanical fabrication will be carried out with the use of steel sheet, welding rods and welding gas during the construction period. Normal construction materials such as cement, bricks, river shingle, sand, deformed iron bar, angle iron bar, hard wood, window glass, roofing sheet, and floor/walling tile will be used for building the various structures like road and drainage, foundation of fuel storage tanks, office buildings and jetty foundation. According to the geotechnical report and data, many 35-50 metres long piles shall be adopted for the piling foundation. The riprap linings and the dike setting retaining wall will be selected as the revetment structure.

3.8 Operation Functions and General Scheme

The fuel unloading pumps are normally incorporated in incoming fuel vessels however the loading pumps are stationed on the farm base. The storage tanks will receive incoming oil products through unloading arms installed at the jetty and the pipelines connected between jetty and storage tanks. Oil product outgoing will be transported by land using trucks on load and by barge on the river. The jetty is designed for both loading/unloading of vessels with 1 x 50,000 DWT OR 2X 5,000 DWT. Ship pumps discharge pressure is 10 bar.

The pipelines from/to jetty will be included 10″ dedicated bidirectional pipeline for bitumen (pipe diameter to be finalized during detailed engineering), 2 × 10 bidirectional and interchange lines for gasoil/gasoline (pipe diameter to be finalized during detailed engineering), 1 × 10″ dedicated bidirectional pipeline for jet fuel and 8″dedicated line for LPG (future).

There will have one dedicated loading arm at the jetty for gasoil, gasoline and jet fuel, and one for LPG (future). Hose connection will be provided on either side of each loading arm to be used for loading gasoil, gasoline and jet fuel onto small barges. A main line using hose will be used to receive (import) bitumen. The main line would have a tee connection on the two sides to discharge (export) bitumen to 2 small barges.

Process control includes automatic tank gauging on the tanks, tank level switches for High and High/High alarms and weigh bridges on the 2 bitumen truck loading positions. Automatic metering systems will be installed at the truck loading positions for white products and LPG (future). Emergency Shutdown (ESD) system will be installed at the truck loading bays to stop the pumps in case of emergency and close the flow control valves at the loading bays.

The storage Terminal will provide bitumen (2 grades), gasoline (2grades), gasoil (2 grades), jet fuel and LPG.

The storage terminal will have to be functioning products import via ships off loading, products export via truck loading, product recirculation on tanks and tank to tank transfers, products export through vessels and LPG export through bottling facility (future).

Products are to be loaded onto trucks by loading positions as follows:

Gasoil: (2 loading positions)

- Considering 10 hours/day operation, loading of 26 trucks will be possible
- Max. Capacity of trucks: 35 m^3
- Max. Product exported via trucks/day: 910 m^3
- Trucks will be loaded from the top using top loading arms
- Loading rate per loading arm will be 1500 litres/min
- 2 loading arms for Gasoil and 1 for premium grade shall be foreseen

Gasoline: (2 loading positions)

- Considering 10 hours/day operation, loading of 26 trucks will be possible
- Max. Capacity of truck: 35 m^3
- Max Product exported via trucks/day: 910 m^3
- Trucks will be loaded from the top using top loading arms
- Loading rate per loading arm will be 1500 litres/min
- 2 loading arms for Gasoline and 1 for premium grade shall be foreseen

There shall be 1 loading position to accommodate trucks being loaded with both Gasoil and Gasoline (ordinary grades).

Jet Fuel: (1 loading position: (Provision for 1 in the future))

- Trucks will be loaded from the top using top loading arms
- Loading rate per loading arm will be 1500 litres/min

Bitumen: (2 loading positions)

- Considering 10 hours/day operation, loading of 26 trucks will be possible
- Max. Capacity of trucks: 30 m^3
- Max. Product exported via truck/day: 780 m^3
- Trucks will be loaded from the top using top loading arms
- Loading rate per loading arm will be 1000 litres/min
- Configuration of loading arms
    - Loading arm shall discharge 1 grade of Bitumen
    - The other loading arm shall discharge another grade
    - The 2 loading arms shall be interconnected

LPG: (2 future loading positions)

- Considering 10 hours/day operation, loading of 20 trucks will be possible
- Max. Capacity of trucks: 16 m^3
- Max. Product exported via trucks/day 320 m^3

Two new positive displacement truck loading pumps of 80m^3/hr each will be installed for loading bitumen. These pumps shall be interconnected. It is foreseen that 1 pump

shall be used for 1 grade of bitumen and the other pump for another grade. One new positive displacement export pump for loading barges/small vessels at 200m^3/hr will be installed. One positive displacement export pump will provide for loading barges/small vessels of 200m^3/hr. Also, pumps shall be used for tank recirculation operations and tank to tank transfers

Two Gasoil Truck Loading Pumps with a capacity of 90m^3/hr will be installed for loading gasoil. These pumps shall be interconnected. It is foreseen that 1 pump shall be used for 1 grade of Gasoil and the other pump for another grade. One Gasoil export pump for loading barges/small vessels at 350m^3/hr will be installed. One export pump will provide for loading barges/small vessels at 350m^3/hr. Also, pump shall be used for tank recirculation operations and tank to tank transfers

Two Gasoline Truck Loading Pumps with a capacity of 90m^3/hr will be installed for loading gasoline. These pumps shall be interconnected. In future, 1 pump will be used for 1 grade of gasoil and the other pump for another grade. A gasoline export pump for loading barges/small vessels at 350m^3/hr will be installed. One export pump will provide for loading barges/small vessels at 35m^3/hr. Also, pumps shall be used for tank recirculation operation and tank to tank transfers. Gasoil and Gasoline export pumps shall be interchangeable. It shall be also feasible to run in parallel.

For the truck station, the plan is : (1) Have 8 fueling positions (four pump islands), (2) Underground steel tanks 4x22500 litres (3) Four units of section type dispensing pumps with two products hoses (one hose gasoline and 1 hose gasoil), and (4) Convenient store.

One Jet Fuel Truck Loading Pump with a capacity of 90m^3/hr and a loading arm shall be installed and one truck loading pump and a loading arm will provide for jet fuel. Two LPG truck loading pumps will be installed for loading LPG in future (bottling facility pumps).

The truck loading terminal is designed to use for loading products as follows:

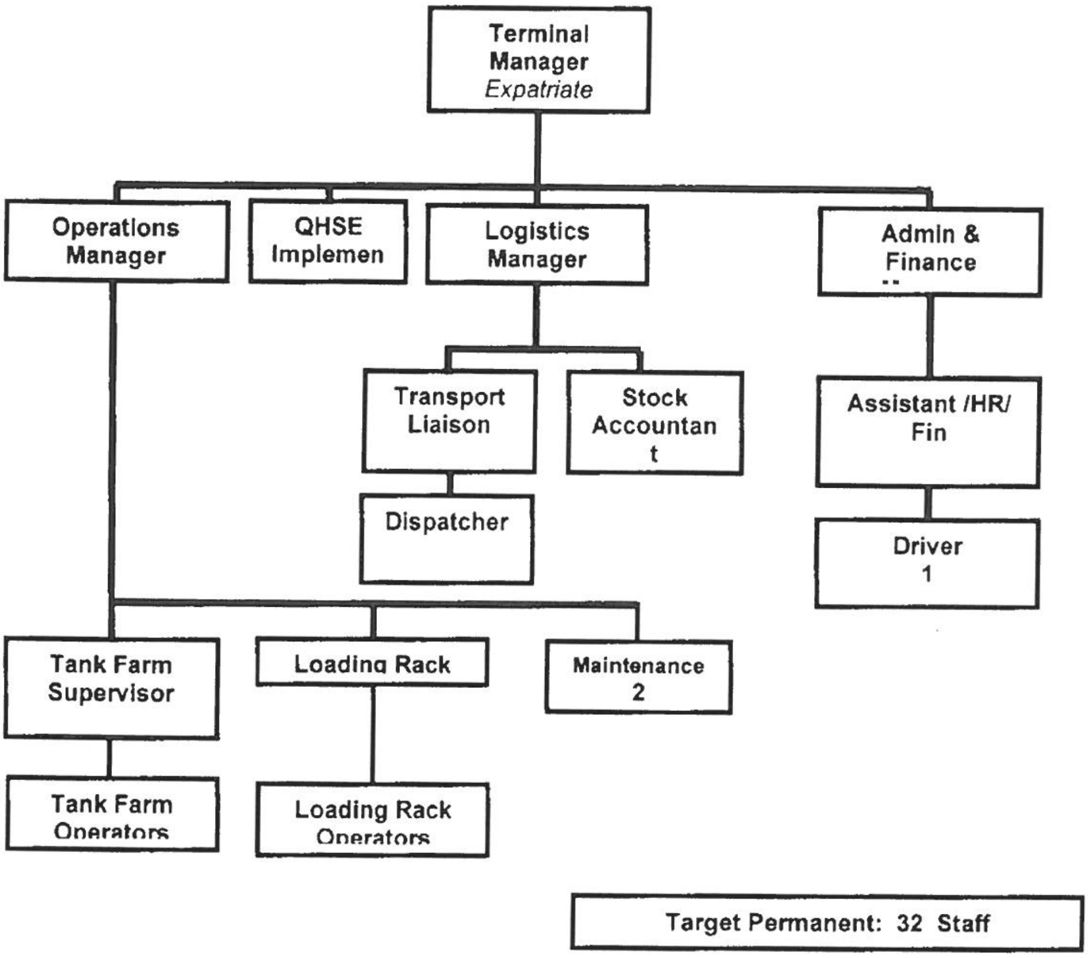
- truck loading positions for bitumen-dedicated
- Gasoil/ Gasoline truck loading configuration
    - Islands with 1 loading arm for gasoil 1 and gasoline 1
    - Loading arms can be positioned left or right of the island
    - Provision for future loading arms for gasoline 2 and gasoil
- 1 truck loading position for jet fuel—dedicated
- 2 future LPG truck loading position-- dedicated

3.9 Decommissioning

A life span for project operation and the structural design life of all buildings and foundations are 20 years and 50 years respectively according to the project design. The given corrosion allowance of the steel structured oil storage tanks is the most influential factor for the project life span. It is expected that the validity of (and/or) decommission or rehabilitation of there will be determined or decided by Myanmar inspection authority and international inspection agencies including insurance companies.

3.10 Staffing

A total of 32 permanent staff will be appointed for the Petroleum Products Storage and Distribution Terminal during operational phase.The organization of the terminal is shown in following chart.



3.11 Project Schedule and Project Cost

Construction and installation of project infrastructures and facilities is scheduled to be complete for1.5years .The total project cost is estimated to be US$ 123million.

4 ENVIRONMENTAL AND SOCIOECONOMIC BASELINE CONDITIONS

The aim for this chapter is to give an overview of the existing environmental conditions against the potential impact over the proposed project influenced area in 2.5 km radius. Strictly speaking, this chapter provides results and findings of the environmental assessment team, which focuses on project related environmental and socioeconomic baseline conditions, socioeconomic status, access to public goods and services, physical environmental status and biodiversity nature in particular.

4.1 Socioeconomic Status

There is no village and residential area within the 2.5 km radius of the defined project impact zone. The closest community called New Phalan Village/ Aye Mya Thida Ward that is located at N 16° 39' 22.4" and E 96° 17' 20.8" is on east bank of Yangon is about 4 km away from the project site.

In this area,there are problems of the low salinity river floods during the rainy season. This area can therefore be classified as a post monsoon semi-agricultural land. The old Phalan village was located in Thilawa Industrial Zone once, and it was relocated to the present location in 1988 by the Department of Human Settlement and Housing Development of the Ministry of Construction for the development of industrial zone. Each household received kyats 20,000 as a compensation for resettlement. The old village was renamed as "Aye Mya Thida Ward" under the administration of Kyauktan Township.

By law, the Thilawa Industrial Zone is the legal owner of this proposed project area now. In some ways, the industrial zone does not seem to have progressed much in the recent years. This creates an opportunity for precious owners of paddy fields to grow on their farmlands or other suitable places to earn their livelihood.

ENCA assessment team conducted a socioeconomic survey in the village administered by Kyauktan Township of Yangon Region.

According to previous surveys, population in New Phalan Village/Aye Mya Thida ward was 620 as of January, 2012. Of which 293 were male and 32 female. There were 63 under 5 year children consisting of 31 males and 32 females and 46 numbers of the elderly over 60 years old among the total population in the village. A hundred per cent of population was Buddhists made up of Bama. The village had 150 households. Out of 150, 137 households had been dwelling for more than 10 years, 4 for 7 to 10 years, 3 for 4 to 6 years, 1 for 1 to 3 years and the remaining 5 for less than 1 year. At present, many economic migrants are found in this village.

People in this village are earning their living by following types of occupation: garment factory employee, wage labour of MITT Company, other company employee, farmer, planting betel-leaf, odd job, livestock breeder, fisherman, government employee, vendor, trader, carpenter, motorbike carrier, shopkeeper, taxi driver, traditional physician, and others (such as broker). The income of households varied widely.Fifty percent of total household earned average income of 0.11 to 0.4 million kyats in three months. The majority of households resided at respective 40 feet by 60 feet plots. Most of the houses in this village are built of wood and CGI roofing. About 30 percent of total houses are built with bamboo mat walling and thatched leave roofing and a few are concrete buildings and brick noggin buildings with CGI roofing.

It can be generally assumed that the building quality of individual houses is a proxy indicator of their wealth living status.It is found out that about 60 percent of the

households were under the poverty line, and most of them were odd job workers but some of them had farmlands in the past. Only about15 percent of the households had a stable income according to the survey.

According to farmers and betel-leaf producers, as they have been temporarily allowed for cultivation in the land, they would have to find alternative jobs when the proposed projects in the Thilawa Industrial Zone become fully developed. The farm labours who were of odd job answered that they seasonally earn from farming and cultivation works. It is estimated to be about 350 tons of average annual paddy production will be reduced after full development of the Thilawa Industrial Zone.

In this village, three households were in their family business on domestic livestock farming, some farmed livestock at individual manageable size not only for their family consumption but also for selling out for urgent money requirement. The cattle were mostly used for farming in their rice field. There were a few fishermen in this village who owned some hand-made fishing tools. Normally they sell the fishes they caught in their village.

Access to public goods and services means to say how people can utilize all public services buildings and facilities that are under the direct control of public or through local government channels. In other words, public goods and services can be defined as provision of health, education, water and sanitation, transport, communication, sport and recreation and social-related activities.

Like in other rural areas of the country, provision of health is very limited in Aye Mya Thida Ward (New Phalan Village). It has only a public clinic. The nearest government hospital is located at the heart of Kyauktan Town about 4.2 km from the village.

There are two schools, a Basic Education Primary School and a Basic Education Middle School with a good coverage of over 1000 households, in this village. The students from nearby residential areas were also attending these schools. The overall education level was reported to be relatively good because of only 4 illiterate.

As that of other parts of lower Myanmar, three water sources have been utilized in this village. Fresh water from hand dug wells and ponds are the main water sources in the past, traditionally utilized for drinking and domestic purposes the whole-year round, in addition to rain water that has limited, restricting only to rainy season. Nowadays, shallow tube wells are constructed by local artisans and about three-fourths of population solely depend on shallow tube wells for domestic purpose such as washing, bathing, livestock feeding and cleaning. However, people reject these tube wells for drinking due to unpleasant salty taste.

Every household in this village has an own private latrine. Most of the latrines are an offset pit design. A few house-holds use a semi-septic design. Household solid waste such as plastics, papers, glasses, cans and other metals are kept separate for sale to buyers who are collecting for recycling. The rest are usually disposed at the back of the house by means of earthling or open burning.

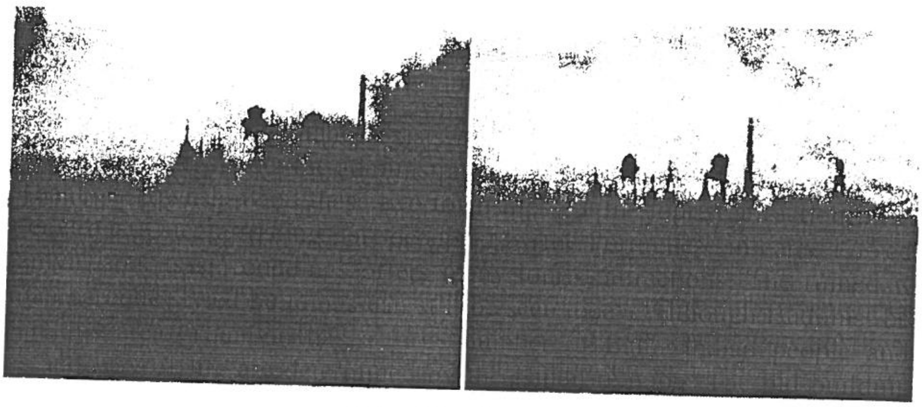
The main road of the Myanmar International Thilawa Terminal (MITT) has been already paved with concrete slabs, which extends toward Thanlyin-Kyauktan main road, it is planned to pave the road with tarmac. At present, there is no bus service in the area but the people from Aye Mya Thida Ward rely on motorbike taxis available at the junction of the Ward for their transport. They can get Thanlyin-Kyauktan road and Thanlyin and Kyauktan towns by taxis or their own, from where they are able to take into the Yangon downtown quite easily.

Distributed generation of electricity has a big role to play as a catalyst for social change. Despite the high voltage lines crossing over their houses, all resettled households in Aye Mya Thida Ward did not have access to common electricity supply line normally provided by the Electric Power Corporation in the past. Since May, 2013, the Electric Power Corporation has distributed power to the village.

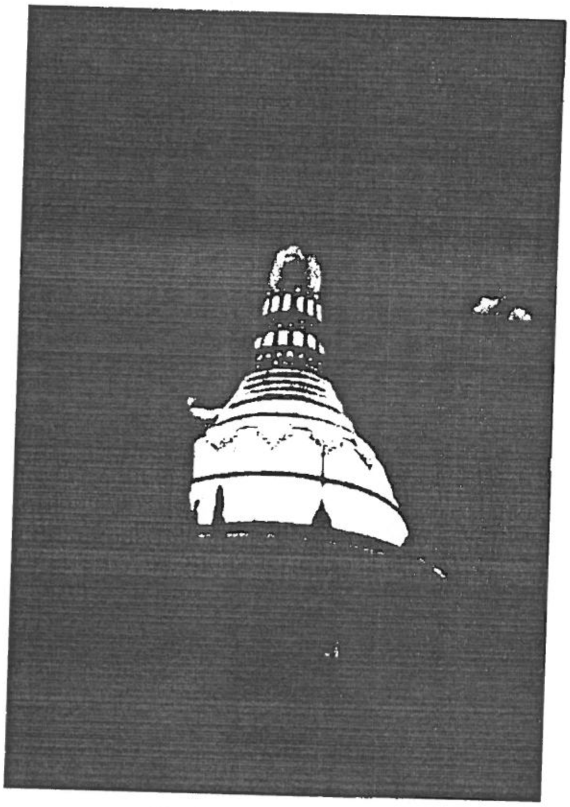
The main responsible body of the public management affairs is the General Administrative Department (GAD) under the Ministry of Home Affair. The Administrator of Aye Mya Thida Ward who is in a subordinate position to the Township Officer of the General Administrative Department is the key person of the official line of contact. Although the role of civil society is still weak, the religiously-based social welfare groups are active in communal events, religious ceremonies, marriage and funeral. The people pay homage to two monasteries located in Aye Mya Thida Ward and the old Phalan Village area. The latter of course was exempt from resettlement. It can be said that the social life of the ward centres on these monasteries.

Religion and Heritage

In actuality, no national inheritance exists in the 2.5 km radius of the considered area. However, the area falls under the administration of Kyauktan Township that is the closet to the Thanlyin Township and these two townships are the tourist attraction in Yangon and its environs. Once a trading port occupied by the Portuguese in early 17th century, the Thanlyin and its surroundings offers many tourist attractions. The ruined wall of Lusitanian baroque styled buildings can still be seen today. Although Buddhist belief is strong in this area, Thanlyin has a large number of Bama-Indian people and their customs and way of life are determined by the Hindu religion. The old buildings still stand in evidence of the days of Portuguese occupation. The 270-metre long bridge spanning the Bago River made possible the 45 minutes' drive from Yangon. Kyaik-kyauk Pagoda and Kyauktan Pagoda in the creek are worth visiting.



Yelae Kyauktan pagoda



Kyaik kyauk pagoda

4.2 Environmental Situation

This section is based on the baseline conditions of environment assessed from the perspective of environmental science. Environmental science is a science of interdisciplinary academic field that includes physical and biological sciences such as ecology, physics, chemistry, biology, social science, geology, atmospheric science and geography. Priority is given to any activity affecting the environmental conditions.

4.2.1 Metrological and Hydrological Status

Myanmar/Yangon has three distinct seasons. The cold season emerges from November to January; dry season starts from February to April followed by the wet season.

Ninety percent of the annual rainfall in project location is monsoonal. Average rainfall on year basis receives 3074.7 mm and the heaviest rainfall in a day is 344 mm (May, 2007). Maximum monthly precipitation reached 709.6 mm in July 2007. A total of annual raining days is 130 days in average. In Yangon, the lowest relative humidity of monthly average is 80%, mostly occurring in March and April. The highest is 93% occurring in rainy season from June to September. The highest temperature in history of 40.8 ˚C was observed in 2005 and the lowest temperature in history of 11 ˚C in 2009. The highest and the lowest monthly average temperatures are 38.8 ˚C and 14.2 ˚C respectively.

In the area, the annual prevailing wind direction is south-westerly. The monthly wind speed is relatively stronger at a maximum of 15.6 – 16.5 m/s in the period between May and August but relatively weaker at 8.0 – 8.5 m/s. Some metrological data is given in ***Annex-1***.

Nature of tide is semi-diurnal, and there are two inflows and two outflows a day. At Yangon station, differences of average tide level, grand tide level and minor tide level are 4.08 m, 5.2 m and 1.8 m respectively. The following tide levels from the plain of Sule Pagoda point used as zero are: the record highest level in history: 7.11m; the lowest level in history: -0.24m; average high level through years: 5.76 m; average low level through years: 0,49 m; and average level: 3.12m.

4.2.2 General Geology and Hydrogeology

Geologically, the proposed area is characterized by recent alluvium overlying the Irrawaddian Formation and Peguan Group, and it is almost a flat area just 2 to 10 m above mean sea level and level enough to extensive rice cultivation. It is more properly a meandering plain, with old meandering features of Yangon River running in a general north-south direction and several short streams with meandering of oxbow lakes and lakes as vestiges as depicted in satellite (see following map) the recent alluvial unit is mainly composed of clayey silt with some sand and lateritic soil. The tank farm site itself is situated on the meandering plain of Yangon River. At the eastern part of the area, where the Para Gyi ridge rises to elevation, the Irrawaddian Formation of Miocene-Pliocene age and Peguan Group are well exposed as lower units.

In this area, lakes and most swamps, usually flooded in rainy season, favour breeding ground of fish and hence fish industry, including those products from ponds in reclaimed swamps and wetlands, is an important local business after rice plantation. Nearby industrially development projects and the projects of special economic zone are now in progress and land use in this surrounding area will change significantly in the near future.

As a drive for examining groundwater quality, lithology and groundwater level in the project site, a 2-inch diameter tube well was sunk to 150 feet deep. Groundwater of the 0 - 150 feet horizon in the project site is highly saline. In fact, water quality of shallow aquifers existing along the east bank of Yangon River is not suitable for domestic, irrigation and industrial purposes. Groundwater levels of the tube wells in this areavary from 3.5 m to 6.5 m depending on seasonal fluctuation and tide levels. The lithology and water quality results of the well installed in the proposed site are presented in***Annex-2***.

However, the studies of groundwater chemistry indicate that the shallow groundwater is of low to moderate salinity in the eastern part of the area including the Special Economic Zones. Although there is little variation in the degree of salinity in the vertical direction (that is, with depth) there is some variation in the horizontal direction (that is, laterally).

During the previous surveys water samples from Yangon River (Station 1 and Station 2), Zarmini reservoir were tested alreadyin ISO-TECH Laboratory in Yangon for testing following parameters: pH, Temperature, Biological Oxygen Demand, Chemical Oxygen Demand, Total Dissolved Solid, Nitrate, Nitrite, Mercury, Chromium, Arsenic, Oil and Grease, Phenol, Sulphate, Chloride, Electrolytic Conductivity, Lead, Turbidity, Alkalinity, Iron, Dissolved Oxygen, Ammonia, Nitrogen, Unionized Ammonia, Free chlorine, Bromine, Iodine, Carbon dioxide, Copper, Silica and Bacterial Growth (***Annex 2***).The water quality results ofabove mentioned water sources and the tube well in the proposed project site are tabulated in ***Table-3***.

Based on water quality test results the river (sea) water characteristics are influential in quality of groundwater in the proposed project site and immediate vicinity and hence it is not suitable for domestic consumption, irrigation use and industrial purpose. No hazards such as rock falls, mudflows and slumps otherwise known as landslides and erosion as a result of a variety of geologic processes have been reported and there is still

nothing to report on discovery of precious stones and valuable economic mineral deposits in this area.

Table 3 Comparison of Water Quality Analysis Results of Zarmani Fresh Water Dam, Tube-well, and Yangon River

Sr. No	Parameter	Units	Reference Value	Dam	Tube well	Yangon River	
						Station 1	Station 2
1	Phosphate	mg/l		Nil		Nil	Nil
2	pH		6.5 – 8.5	7.2	7.2	8.4	7.6
3	Colour (True)	TCU	15 TCU	Nil	30	40	50
4	Turbidity	NTU	5 NTU	10	80	110	128
5	Conductivity	µS/cm		42	2450	124	114
6	Total Hardness	mg/l	500 mg/l	16	160	48	50
7	Total Alkalinity	mg/l		18	124	52	52
8	Phenolphthalein Alkalinity	mg/l					
9	Calcium Hardness	mg/l		10	98	30	32
10	Iron	mg/l	0.3 mg/l	0.56	1.58	6.00	6.60
11	Magnesium Hardness	mg/l			62		
12	Manganese	mg/l	0.05 mg/l				
13	Carbonate ($CaCO_3$)	mg/l					
14	Chloride (as Cl)	mg/l	250 mg/l	7	690	10	10
15	Sodium chloride (as NaCl)	mg/l		12	1139	17	17
16	Bicarbonate (HCO_3)	mg/l		18	124	52	52
17	Sulphate (as SO_4)	mg/l	200 mg/l	Nil	122	10	10
18	Total Solids	mg/l	1500 mg/l	37	1376	190	220
19	Suspended Solids	mg/l		18	138	131	166
20	Dissolved Solids	mg/l	1000 mg/l	19	1241	59	54
21	Phenolphthalein Acidity	mg/l		2		2	2
22	Methyl Orange Acidity	mg/l					
23	Salinity	ppt			1.3	0	0
24	Temperature (˚C)	˚C			27.2	28	29
25	Fluoride (F)	mg/l	1.5 mg/l				
26	Lead (as Pb)	mg/l	0.01 mg/l	Nil	Nil	Nil	Nil
27	Arsenic (As)	mg/l	0.01 mg/l	Nil	Nil	Nil	Nil
28	Nitrate (N.NO_3)	mg/l	50 mg/l		Nil		
29	Chlorine (Residual)	mg/l		Nil	Nil	Nil	Nil
30	Ammonia (NH_3)	mg/l		0.30		0.24	0.30
31	Ammonium (NH_4)	mg/l					
32	DO	mg/l			2.80	4.5	4.5
33	COD	mg/l		40	110	320	352
34	BOD (5 days at 20 ˚C)	mg/l		16	44	128	176
35	Oil & Grease	ppm			Nil		

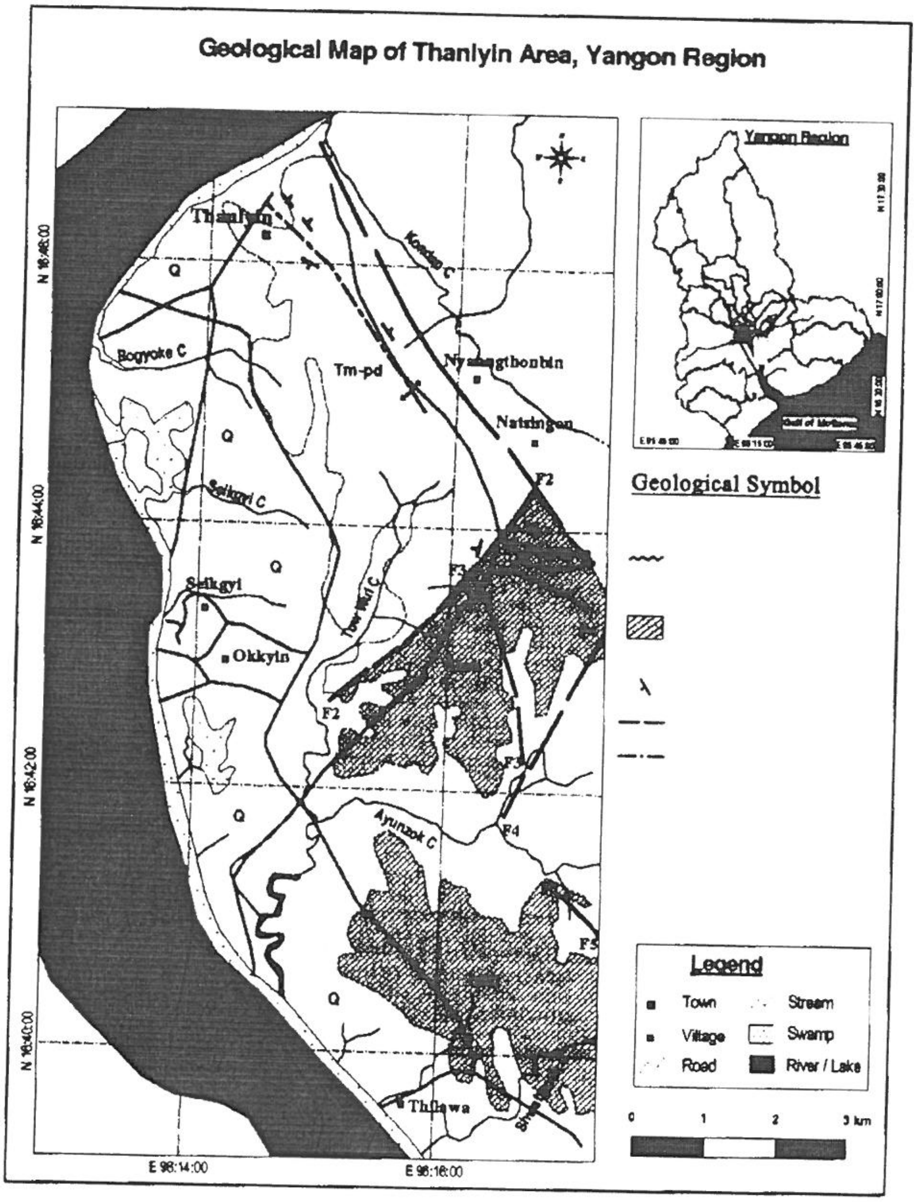


Figure 1 General Geology

4.3 Ambient Air

For ambient air quality testing, the administrative area at the elevation of 11 metres and the storage area at the elevation of 19 metres were selected as two sample sites. Measurements of Total Suspended Particulate Matters (TSPM), Respiratory Particulate Matter (PM_{10}), Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2) in 24-hour mean and Nitrogen dioxide for 1 hour and Ammonia and Carbon dioxide in the ambient air were taken. Based on 24-hour measurement level of TSPM and PM_{10} each sampling period was identified by using high volume sampler with a glass-fibred filter and SO_2 and NO_2. The results are mentioned in ***Table-4***.

4.5 General Characteristics of Yangon River

The Yangon River which starts from the confluence of Bago and Hlaing Rivers in the south of Yangon City flows generally southward to its mouth in the Gulf of Martabin. The Bago River originates from the southern portion of Bago Yoma and the Haling River rises in a western extension of Bago Yoma near Okkan Town. In the Yangon River, as in the Bago, there has been excessive silting due to erosion and sedimentation. That is estimated to be 37 tons of silt per year.

The Yangon River is the most important maritime access to Myanmar. The narrowest point is located in Hmawwun Lump buoy with a 650 metre width, where a 39 course alteration is required to pass through in this rift define, and the Middle Bank at the upstream is the second highest. The average tidal range and the mean tidal range at the Elephant Point (the sea entrance to Yangon River) are 5.76 m (18.9 ft) and 4.27 m (14 ft) respectively during the spring tide period, and the average tidal velocity is 2 to 3 m/s. The maximum surface wind speed 40 – 50 mph (34.7 – 43.5 nautical miles/hr) is observed during the monsoon. Non-machine fishing boats and fishing gears can be seen along the Yangon River approach. The allowable depth to enter for draught vessels is the Outer Bar of 5.18 m below the chart datum and the Inner Bar of 3.96 m. Between the Inner Bar and Outer Bar is 17.38 nautical miles distant. Vessels departing from Yangon Port have got to cross the Outer Bar in time otherwise they would have anchored at the port and waited for the required high tide.

The new Thilawa Port has some significant strength that lies in deduction of navigation time, Fairway anchorage waiting time and traffic congestion. It can also accommodate larger size containers and cruise ships. The ship sailing with tide from the Fairway to the Thilawa Port takes 2 to 2⅓ hours and the sailing time for outgoing vessel from Thilawa Port to the fairway is 2⅙ to 2⅔ hours (against tide) compared to the Yangon Port which is being used by vessels with a maximum capacity of 15,000-tons, 167-metre length and 9-metre draft. The Thilawa can accommodate 20,000-ton, 200-metre length and 9-metre draft.

There are 16 jetties at the Yangon Port and 6 jetties at Myanmar International Terminal Thilawa (MITT) along the Yangon River already. A total of 22 vessels can therefore be moored simultaneously. According to ongoing port development plan, Yangon River capacity is expected to increase jetty facilities as well as accessibility of bigger ships with deeper draft in the near future.

4.6 Biodiversity in the area

Priority areas for biodiversity conservation in Myanmar includes Key Biodiversity Areas KBAs, Important Bird Areas IBAs*, Primary corridors, Endemic Bird Areas EBA*and secondary areas and lastly Protected Areas System # PAS of Myanmar. Any development or industries in or adjacent to these areas should be avoided to prevent any destruction to the habitats and globally threatened species and biodiversity.

This project area lies at the southern edge of the Irrawaddy (Ayeyarwaddy) Plain Endemic Bird Ares EBA 132 and the expected endemic bird expected to find here is White-throated Babbler *Turdoidesgularis*. Earlier in January 2012 ornithological survey in this same area recorded this species. This species is considered **least concern** by **IUCN** and is not given priority for conservation.(See results ofornithology survey in ***Annex-4***)

4.6.1 Flora

The flora survey team collected and identified a total of 97 species, 76 genera and 34 families of plants from this area. Most of the plant species were from human settlement areas, in old-paddy fields and mangroves along the river side.There were neither globally threatened species recorded from this area nor any of them can be classified as locally important plant. However growing local plants individually or raising green tree plots would serve as a good asset for the environmental preservation. Material and methods, names of scientists and the list of plants and some recorded photos of these are as shown in ***Annex-3***.

4.6.2 Fauna

Birds

Birds are one of the most diversified of all creatures living on earth. They are well studied in all regions around the world. Conservationists from different fields have accepted that birds are the best indicators to identify the most biologically rich areas, as well as environmental changes and problems.

But bird species around the world have declined dramatically and this drastic decline is mainly due to excessive hunting, and destruction of natural habitats of birds. Many species have now become extinct and most species are struggling for their existence on the world.

Information and status of birds in this report are in reference to guidelines and red list data published by BirdLife International. **BirdLife international is the official IUCN Red List Authority for birds.** The list of recorded birds, materials and methods, name of scientists and their habitat conditions are shown in ***Annex-4***

Reptiles and Amphibians (Herpetofauna)

Reptiles and Amphibians occupy a wide range of habitats and niches within ecosystems. Herpetofauna are important components of tropical ecosystems. They play a major role in complex aquatic and terrestrial ecosystems especially aquatic habitats (Baard and de Villiers, 2000). They make up major components of tropical vertebrate diversity, comprising typically twice the number of mammalian species, providing important food resources to other species. Also it is a useful group for understanding the effects of a wide variety of environmental changes to tropical forests at the community level and on biodiversity more generally. Unfortunately Amphibian diversity is in rapid decline worldwide for a number of different causes including habitat loss and fragmentation, climate change, environmental contamination, as well as the invasion of exotic species, including pathogens (Alford and Richards, 1999; Blaustein and Kiesecker, 2002; Stuart et al., 2004; Araujo et al., 2006; Cushman, 2006; Pounds et al., 2006). Reptiles face similar suites of problems and a number of taxa are experiencing severe range reductions and declines in abundance (Gibbons et al., 2000; Araujo et al., 2006). The herpetofauna of Myanmar is poorly known. And a large proportion of taxa remain un-described or as yet undiscovered and still discovered. At present, there are 82 amphibian and 289 reptile taxa (Zug et al., 2003) documented in Myanmar.

- During the survey conducted in July, 2013, a total of 15species of reptiles and amphibians belonging to 9 families were recorded.

- Seven species of amphibians and 8 species of reptiles were observed.The list of the recorded reptiles and amphibians, material and methods and name of scientists are shown in ***Annex-5***.

<u>Small Mammals</u> (e.g., rodents)

Small mammals are the most diverse group and account for more than half of the total mammal fauna in any given area. They affect the structure, composition, and dynamics of ecosystems through natural processes such as pollination, seed dispersal and depredation, mycorrhizal dispersal, insectivory, and as food for predators (DeMattia et al. 2004; Mangan and Adler 2002; Muchhala and Jarrín-V 2002; Napolitano et al. 2008; Naranjo et al. 2003; Steiner 1981; Vieira and de Moraes 2006; Walker et al. 2007; Williams-Guillén et al. 2008). Myanmar occupies one of the richest mammalian for any country.A total of only one mammal species was encountered during the survey; one species belonging to family *Muridae*). The material and methods, names of scientists and the list of recorded small mammals are shown in ***Annex-6***.

Understanding the world's biodiversity is a central goal of ecological, evolutionary, and conservation sciences. Biodiversity is a basic support system for life, which represents a system of many interdependent processes (Nunes, 2003). Myanmar occupies one of the richest mammalian for any country. Small mammals such as bats are good indicators of habitat disturbance (Castro-Luna et al. 2007; Medellín et al. 2000; Solari et al. 2002; Wilson et al. 1996). Of them, small mammals have been particularly useful in the study of elevational gradients, mainly because they form well-defined assemblages (in contrast to medium-sized and large mammals) along such gradients (Lomolino 2001; Mena and Vázquez-Domínguez 2005; Patterson et al. 1998). Small mammals (e.g., bats and rodents) are the most diverse group and account for more than half of the total mammal fauna in any given area. They affect the structure, composition, and dynamics of ecosystems through natural processes such as pollination, seed dispersal and depredation, mycorrhizal dispersal, insectivores, and as food for predators (DeMattia et al. 2004; Mangan and Adler 2002; Muchhala and Jarrín-V 2002; Napolitano et al. 2008; Naranjo et al. 2003; Steiner 1981; Vieira and de Moraes 2006; Walker et al. 2007; Williams-Guillén et al. 2008). In the present study was carried out to know the occurrence and diversity of small mammals' presents in the Oil storage project, Thilawar environs.

Similarly flora, aquatic, mammal and herpetological surveys also reveal no significant threats to important habitats and loss of globally threatened species.

Moreover the project area lies far from any IBA, KBA, PAS and primary corridors.

The details of the flora, fauna and aquatic surveys are shown in ***Annex-3***to 7.

4.7 Results of Investigation of Aquatic organism

Fossil oil is toxic to aquatic life if ingested or absorbed through the skin. It also fouls the fur and feathers of wildlife and smothers aquatic habitats and beaches. Leakage of oils, oil wastes and mixtures may directly cause damage to fishery resources, aquatic biota and coastal habitat. Biodegradation of oil also generates polymerized oil particles and toxic aromatic fractions using dissolved oxygen in the water, which indirectly cause damages to bottom biota and habitat. Both effects may seriously damage coastal ecology. Fishery resources, including shellfish, may be spoiled by oil and toxic substances generated by biodegradation. Some oils contain carcinogens and their contamination has been reported in fishery resources.

Based on these concerns, a baseline survey focusing aquatic ecological conditions, aquatic organisms and fish species was carried out in the downstream of Yangon River that is the confluence of Hlaing River, Pazundaung Creek and Bago River and Hmaw Won Creek. The investigations covered 6 kilometers distance of upstream and downstream of the project site. six stations were designated and survey works carried out.

Relating to the aquatic ecological conditions, the measured physio-chemical parameters were: air temperature, water temperature, mud temperature, pH, salinity, water transparency and dissolved oxygen (DO).The aquatic related water quality and environmental conditions examined at six stationed points are shown in ***Annex-7***.

The survey on Phytoplankton, Zooplankton and Meroplankton was carried out at 6 locations. Phytoplankton was collected using 25# mesh and zooplankton, using 13# mesh plankton nets and preserved with formalin. The secchi disc was used for measurement of water transparency. The analytical results were recorded in the form of the phytoplankton, zooplankton and the meroplankton check list of ***Annex-7***.

Fish samples were collected from local fishermen.The collected fish samples are listed in the fish check list shown in ***Annex-7***. The corresponding fish photos are shown in ***Annex-7***.

The results and findings of this aquatic survey suggested the following discussion points.

- All water quality results are within acceptable range for aquatic organisms except turbid water colouration of the river. Water quality parameters such as salinity, pH and dissolved oxygen (DO) varied depending on tide resulted by salt water and freshwater effects.
- The flow rate of July survey is relatively faster and the weather is rough because of the monsoon season. The other physicochemical parameters are not very much different from previous surveys periods except salinity because of different volume of freshwater flow from the upstream of the river.
- Results showed that phytoplankton and zooplankton were more common euryhaline species. Some typical freshwater species were recorded in the low tide but not common. This indicates that the water quality of survey area is predominantly fresh water in July survey because of heavy rain and flow of freshwater from the upstream rivers of Hlaing River, Bago River and Pazundaung tributary into Yangon River. Therefore, species composition of plankton is predominantly brackish and fresh water species in survey area. According to theory, exclusively marine species or, at least, meso-polyhaline brackish species can be recorded during high water and freshwater species during low water. Actually, high water samples were more or less the same as low water sample. As a matter of fact the Yangon River estuary is dominantly populated by fresh water or brackish species at all times, that is, during both high tide and low tide periods. The very turbid condition in combination with the severely polluted condition has serious detrimental effect on the phytoplankton and subsequently, zooplankton.
- The pollution condition is extremely severe during low tide. The sewage and industrial waste discharged from the mega-city of Yangon (with a population of nearly 6 million) has made the area undoubtedly the most polluted water body in Myanmar. The incoming seawater during high tide neutralizes the severely polluted water and carries away all the waste into the sea during the outgoing low tide. The influx of very large volume of seawater into the area greatly mitigated the effect of pollution and helped preserve the biodiversity of the area.

- In meroplankton composition of July survey, most are invertebrate larvae which are food organisms for higher level of food pyramid. Higher level food pyramid organisms of fish and shrimp larvae were also found in the samples but the quantity was not much. This means that July is not breeding season of higher level food pyramid species. In July survey, fish and shrimp larvae were dominantly found in the samples..
- Fishery is important livelihood of natives around the survey area of Yangon River. Therefore, most of the species recorded were economically important species such as Nga tha lauk, Nga poke thin, Nga bat and Nga kun shat which are important export species for Myanmar. All other species are also important for local consumption. If water quality of survey area is not affected by pollution, fishery will be stable in the survey area and livelihood of natives will not be affected significantly.

4.8 Eco systems and habitats in that area

The proposed project area lies in the deltaic coast of the Ayeyarwaddy River with no significant character. It is not included in any of endemic bird area and key biodiversity area. In the whole area, there are expanses of open paddy land and small scattered wetland combined with tall, rough elephant grass. Small scattered wetlands combined with shrub and tall elephant grass intersected by paddy fields dominates the whole area. The vegetation along the coast and water edges is composed of mangroves with stunted growth.

(a) **Global Climate Regulating Services:** a few big trees growing in the area can sequestrate minimal amount of carbon and hence it would be negligible to provide ecosystem service in this area.

(b) **Water Services:** Local people in this area do not use water from wetland because they existing fresh water ponds and groundwater sources for domestic purpose. However, there are 4 or 5 fishermen relying on fishery and sometimes they can afford USD 7 per day from fishing.

(c) **Harvested Wild Goods:** No significant wild goods are harvested from the ecosystem because of less development of wetland and mangroves in the area.

(d) **Nature-based Tourism and Recreation:** Ecotourism is to enjoy the nature; this area does not belong to biodiversity and scenic beauty to attract tourists and visitors. Also there are no tourism services in this area according to biodiversity and social impact assessments. Impact on service provided in this respect is very minimal or none.

(e) **Cultivated Good:** as mentioned in the previous section of this report, it is still producing rice in this area. Local farmers have received a certain amount in a compensation of paddy fields and changed their livelihoods to other suitable alternatives. Therefore a service for ecosystem will be only a minimal amount.

4.9 Economic Zoning

The Department of Human Settlement and Housing Development (DHSHD) initiated the development of Thilawa Industrial Zone. It had a plan to form a Special Economic Zone (SEZ). The plan was delayed till due to enacting the SEZ Law. Myanmar International Terminals Thilawa (MITT) and Myanmar Integrated Port Ltd. (MIPL) had been established over a decade for development of the project. The plan of SEZ includes Special Industrial Zone (for FDI) of 2.300 acres, Local Industrial Zone of 430 acres, Singapore--Myanmar Development Industrial Zone of 247 acres, sea ports and container yard and Thilawa Special Economic Zone of 3170 acres.

Due to its favourable locations and accessibility making possible a 45 minutes' drive at any time from Yangon downtown and 4 hours travelling time from the mouth of the Yangon River, eyes of foreign investors and developers are keeping an this Thilawa Special Economic Zone for potential investment.

5 POTENTIAL SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

The purpose of this section is to identified and considered the most pertinent socio-economic and environmental impacts and to provide possible mitigation measures that are expected from the feasibility study, planning and design phase, the construction phase and the operation phase including cumulated effects by long term operation.

5.1 Significant Socio-economic and Environmental impacts

The contents of the three phases as mentioned above are: (1) Impacts during feasibility studies, planning and design: impacts on agriculture and land use and impacts on employment and economic opportunity; (2) Impacts during construction phase: impacts on employment and economic opportunity, impacts on health and safety, impacts on air quality, impacts on water quality, impacts on noise level and impacts on traffic and transport; and (3) impacts during operation phase: impacts on employment and economic opportunity, impacts on health and safety, impacts on air quality, impacts on traffic and transport, impacts on biodiversity cumulative impacts and potential disaster risks and hazards.

5.2 Impact Evaluation Criteria

To classify the degree and extent of impact, four fundamental criteria are used for determination of overall importance or significance even if a particular evaluation was attributable to a value judgement – qualitative rather than quantitative data that is not available. This methodology is able to establish acceptable levels and recommend necessary mitigation and monitoring measures to minimize or eliminate impacts. The following criteria are used to evaluate the overall importance of impacts:

Nature of impact: As project area is located on the East bank of Yangon River, natural spring tide normally hit over the area especially in the rainy season. This river tidal-water possesses relatively high saline content which is neither good for paddy field nor people living but mangroves could flourish. If we focus or think about this project area alone, this proposed project is said to have no direct impact on agriculture and land use mainly in terms of issues in relation to rice cultivation and land ownership. However some indirect impact can be expected based on the past actions of the Thilawa Zone land development plan. In other words, the farmers who have to give up their opportunity to use land temporarily will not be happy and that climate would possibly lead towards social tension between developers and native residents.

Duration of impact: The nature of land and its green effect will be changed permanently.

Extent of impact: It is isolated by the project area regardless of the whole Thilawa Industrial Zone.

Intensity of impact: It has very low intensity regarding impact of agriculture and land use.

To have an easy impression, the impact evaluation is summarised and tabulated below:

Table 6 Impact evaluation

Sr.	Classified Impacts	(a) Nature, (b) Duration, (c) Extent and (d) Intensity of Impact & (e) Mitigation		
		Planning & Design Phase	Construction Phase	Operation Phase
1	Impacts on Agriculture and Land Use	a) Negative, but no direct impact b) Permanent c) Isolated d) Very low e) Socio-eco assistance	–	–
2	Impacts on Employment and Economic Opportunity	a) Positive direct impact b) Temporary c) Isolated d) Low e) NA (not applicable)	a) Positive direct impact b) Short term employment, Long term economic c) Isolated d) Moderate e) NA	a) Positive direct & indirect impact b) Long term employment, Long term economic c) Local d) Medium e) NA
3	Impacts on Health and Safety	–	a) Negative, both direct and indirect impact b) Temporary c) Isolated d) Depend on problem e) Provide adequate facilities & control sewage and solid waste	a) Negative, direct /impact b) All time at plant operation c) Local d) Depend on problem e) Adapt international occupational health and safety standards
4	Impacts on Air Quality	–	a) Negative, both direct and indirect impact b) Temporary c) Isolated d) Depend on problem e) Implement the dust control measure	a) Negative, direct impact b) All time at plant operation c) Isolated d) Low e) Proper design selection, import unleaded gasoline
5	Impacts on Water Quality	–	a) Negative, direct, but no effect on drinking water b) Temporary (<1.5 year) c) Isolated d) Low e) Comply standardized waste disposal methods	a) Negative, direct impact b) All time at plant operation c) Isolated d) Low e) Proper selection of sewage treatment plant; Comply standard of treated sewage water quality and disposing methods

Sr.	Classified Impacts	(a) Nature, (b) Duration, (c) Extent and (d) Intensity of Impact & (e) Mitigation		
		Planning & Design Phase	Construction Phase	Operation Phase
6	Impacts on Noise Level	-	a) Negative, direct, but no effect on resident area b) Intermittence c) Isolated d) Low e) Comply noise standard, avoiding noising work at night time	a) Negative, direct, but negligible b) All time at plant operation c) Isolated d) Negligible e) Comply noise standard
7	Impacts on Traffic and Transport	-	a) Negative, direct b) Intermittence c) Isolated d) Low e) Proper arrangement on movements of vehicles and transporters	a) Negative, direct b) Intermittence c) Isolated d) Low e) Oil-distribution-trucks should avoid peak-hour movement
8	Impacts on Biodiversity	-	-	a) Almost none b) Permanent nature but not relevant c) Isolated d) Almost none e) NA
9	Cumulative Impacts	-	-	Potential impact on the costal ecosystem by the overall development of Thilawa Industrial Zone e) Setting up an Integrated Coastal/terrestrial Management System (ICM)
10	Potential Disaster Risks and Hazards	-	-	Fire hazard is the most potential one. e) Proper design selection of fire fighting system and lightning protection system

5.3 Proposed Mitigation Measures

As mentioned above, this EIA recommends mitigation measures associated with potential impacts identified that seems an unbinding resolution to create outer-bound for who have committed to comply international and/or local environmental standards. It may mainly concern contractors under the project design and construction phase, and managers and executive branch of the investment company during the operation phase. Mitigation and supporting measures are therefore best achieved through the incorporation of suitable clauses in the construction documents. It would then be the responsibility of the supervising engineer to ensure that the contractor abides by the requirements of these clauses.

5.4 Impact During Feasibility Studies, Planning and Design

5.4.1 Impact on Agriculture and Land Case

This proposed project area was under the legal ownership of the Thilawa Industrial Zone in late 1988. The area of proposed oil tank farm is 83.75 acres, about 2% of the total planned are of Thilawa Zone. The area of Thilawa Zone is 6,000 acres in total. Despite the ownership of Thilawa Industrial Zone by law, the former owners of farmlands took opportunity to cultivate rice on them until the last year growing season due to the situation of stagnation in project development.

Nature of Impact: Normally, the project area located on the east bank of Yangon River suffers from the natural spring tide especially in rainy season. This highly saline tidal-water is not good for paddy fields and people living there but mangroves would flourish. Mainly in terms of issues related to rice cultivation and land ownership, the proposed project is said to have no direct effect impact on agriculture and land use. However, some indirect impacts can be expected on account the past actions of the Thilawa Zone land development plan. The climate between developers and native residents would possibly lead towards social tension because the farmers who have to give up their opportunity to use land temporarily will not be happy.

Duration of impact: Permanent changes will occur in the nature of land and its green effect.

Extent of impact: Regarding impact of agriculture and land use it has very low intensity.

Mitigation measures: in accordance with the project layout plan, green grass, flower plants and trees will be grown at any vacant space to achieve 19 % green coefficient as having considered in the project design for green effect. The disgust of former landowners is considered as indirect impact meaning that it is not directly incurred by the project. However, in order to minimize the potential social tension, the Thilawa Industrial Zone as a whole should consider socio-economic assistances to those affected communities.

5.4.2 Impacts on Employment and Economic Opportunity

The designing works for the project have been mostly carried out by foreign companies. The impacts on employment and economic opportunity are thought to be quantitatively negligible during the feasibility study, planning and design stage. However, the staff of Puma Energy Thilawa Terminal Co.,Ltd. engineers in particular, will have a good chance to interface some design expectations of the modern technologies. The employment opportunities of such activities like initial ground measurements, primary site clearing and geological and hydrogeological surveys will be of benefit to local people in the form of casual labours or service contractors. Moreover the Thilawa Industrial Zone development, inclusive of this proposed project, will improve on infrastructure and public services (health, education, security, drinking water and waste water management, food, and electric power supply, in this area, which would be able to give a significant impact on the quality of life of local residents.

- **Nature of impact:** Positive and direct impact
- **Duration of impact:** Temporary
- **Extent of impact:** Isolate
- **Intensity of impact:** Low

- **Mitigation measure:** NA

5.5 Impacts During Construction Phase

5.5.1 Impact on Employment and Economic Opportunity

Hundreds of employment opportunity will open up for local people to be employed as local unskilled and semi-skilled labours more than one year during the construction phase. The project will provide tens of local service providers and suppliers with new sub-contract works. The incoming new technologies will be replicated through skill workforce and supporting services will be internationally more competitive than what it is at the moment. The project will surely boost local production of construction materials such as brick, sand and river shingle.

- **Nature of impact:** Positive and direct impact
- **Duration of impact:** The employment will be shot term. The economic opportunity will be medium term.
- **Extent of impact:** The employment will be local and the economic opportunity will be on regional scale.
- **Intensity of impact:** Moderate
- **Mitigation measure:** NA

5.5.2 Impacts on Health and Safety

The construction and installation activities of the proposed project site clearing and earth filling, excavation, construction of road and drainage, civil structural and building construction, mechanical fabrication, foundation and piling, piping and installation of electrical facilities etc are areas of occupational health and safety in association with the direct negative impacts. There are also some negative impacts can be caused by the interaction of outside workers with the local population during the oil tank farm construction that would increase the spread of transmittable disease like STD and HIV/AIDS.

In the environmental health perspective, the management of sewage and solid waste is considered to be a major concern of public health, which, here focuses on two areas: the first one is the daily living sewage produced by more than 100 workers and their solid waste and the second is the various metal and non-metal waste by construction activities. Both sewage and solid waste should be controlled by providing adequate facilities and practicing proper use, care and maintenance.

- **Nature of compact:** Negative impact; both direct and indirect impacts
- **Duration of impact:** Throughout the construction process that will last for 18 months; to be considered medium term
- **Extent of impact:** Isolated
- **Intensity of impact:** Depends on type and scale of the problem arose
- **Mitigation measures (General):** Construction contractor must brief all staff members on potential risks of injuries on site for safety. The contractors will provide not only adequate protection equipment including helmets, safety gloves, safety boots, safety belts, ear plugs, etc but also adequate drinking water, sanitation facilities, washing and change facilities and emergency facilities including first aid

kits, and comply to local safety standards as well as international standards relevantly. For social, health and security reasons, a temporary site camp for storage and workshop will be built outside the project compound. To safeguard the premises, protect fire accidents avert criminal activities, the entire site will be fenced off and security personnel will be employed.

- **Mitigation measures (Sewage and solid waste):** it is absolutely imperative to ensure provision of adequate and quality sanitation facilities as well as to encourage/promote worker hygiene. A set of one toilet and one urinal with toilet facilities like soap, toilet paper, clean water and garage bin/bags should be provided for 30 construction workers on average. The latrine must be fully proof either semi-septic or septic latrine. The managers and supervisor will organize the workers' group-discussion on promotion of the sanitation and hygienic behaviour and practices on regular basis. Waste of construction materials should be recycled as much possible. A better way of disposing of the solid waste including the living waste and construction waste except recyclables will be to follow the guidelines and instructions given by the Yangon Port Authority.

5.5.3 Impacts on Air Quality

Foundation and earthworks emit fugitive dust, transporting materials may generate dust and vehicles and pile-deriver machines emit exhaust gas, these may cause the negative impact on air quality in the immediate vicinity of the work site during the construction phase. Most of them are driven by diesel engines that emit exhaust gas. Gaseous pollutants like Nitrogen Oxide NO_x, carbon monoxide CO and Hydrocarbons

- **Nature of impact:** Negative and Direct impact
- **Duration of impact:** Temporary
- **Extent of Impact:** Isolated
- **Intensity of impact:** Low
- **Mitigation measures:** To limit dust rising during the earthwork operations, the dust form of earthen particles can be made damp by spraying with water. Each and every truck vehicles will be covered for carrying construction materials such as cement, sand, soil, gravel etc. In order to prevent spreading of dust in the construction areas, wheels of those trucks and vehicles will be cleaned before going out to public access road. All vehicles, machines and any types of combustion engines with relevant safety design and standards and set permissible limits of exhaust emission will used in the construction site.

5.5.4 Impacts on Water Quality

Fuel leaked out of heavy machineries and improper disposal of used lubricant are frequently found in many construction operations. The leaking fuel and refuse lubricant can easily infiltrate into the soil while some of them can run off to the river through drain channels during the rainy season. In this proposed site, the permeable top soil with wood decay at the depth of 18 to 20 m section is composed of alluvial sand. Moreover, the levelling process of filling sand for 0.5 m to 3m may render this tip soil layer more permeable and oil contaminants and waste of chemical including liquid cement have a greater chance to penetrate into the soil. Accordingly, the groundwater can be simply contaminated by the petroleum products. However, the ebb and flow of tide can wash some contaminants out to the river. Another source of contamination is inadequate sanitation facilities that can make the quality of river water decline and groundwater as

well. Regarding quality of water in Zarmani reservoir which is potential drinking fresh water source, it is located at the about 5 miles away from the project site, by no mean will not have any negative impact on the water body of the dam. The impact of water quality related to soil erosion is insignificant.

- **Name of impact:** Negative and direct impact (no effect on drinking water source)
- **Duration of impact:** Temporary (less than 1.5 years)
- **Extent of impact:** Isolated
- **Intensity of impact:** Low
- **Mitigation measures:** the constructor will have to comply fully with local and international standards of waste disposal. In compliance with Yangon Port Authority directives all potential pollutants, hazardous materials, petroleum products, lubricants, hydraulic oil, paints and coatings shall be stored in an approved container and disposed. The 50 m free space between the structural construction and rive bank has been allowed for sufficient design to protect soil erosion and the revetments will be built along the river bank.

5.5.5 Impact on Noise Level

The noises of construction equipment like pile-drivers, dozers, scrapers, road rollers, concrete mixers, cranes, generators and compressors etc during the operation time will disturb the neighbours. The noise levels depend on the types of activity performed; for example, a front end loader will generate the noise on the level of 100 decibels (dBA), while a truck will make approximately 85 dBA. The noise of a vehicle should not exceed 85 dBA measured at 7.5 metre or not exceeding 100 dBA measured at 0.5 metre according to Thai Environmental Allocation. It is commonly mentioned that the night time sound level should be around 40 dBA. There is now very less possibility of noise effects to the residential area located at the distance of 2.7 km.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** Temporary (but also intermittence)
- **Extent of impact:** Isolated
- **Intensity of impact:** Low
- **Mitigation measures:** The main contractor and sub-contractors will take their responsibility for a desirable noise level being maintained on the course of national norms, regional standards and WHO guidelines. Despite local residential area being in a far distance, the contractors should try to avoid noisy construction works in the night time to prevent sleep disturbance to the workers sleeping in the construction site.

5.5.6 Impacts on Traffic and Transport

The main access road from MITT to Thanlyin-Kyauktan road and the ring road of Special Economic Zone were under construction at the time of the environmental assessment survey conducted. Currently, the project site is in an undeveloped area. Only a few companies are being started yet. There is now no traffic problem inside the industrial zone. However, it can be expected that the area will be congested with traffic especially on the way via Thanlyin to Yangon during the construction period. It will create inconvenience to the local population, alter traffic problems, and increase the risks of accidents. In order to avoid the issues most of the construction materials, heavy duty

machineries and equipment will be carried by boat through Yangon River. Hopefully, significant traffic issues may not occur.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** Temporary (but also intermittence)
- **Extent of impact:** Isolated
- **Intensity of impact:** Low
- **Mitigation measures:** The contractor or his on behalf will have to liaise closely with the relevant for traffic authorities for ensuring road safety, smooth traffic flow and schedule movement of vehicles and transporters avoiding peak hours.

5.6 Impacts During Operation Phase

5.6.1 Impacts on Employment and Economic Opportunity

This project will have about 90 – 100 opportunities. Out of these new jobs, half will be beneficial to local residents who are living near the Thilawa Industrial Zone. The development of Thilawa Industrial Zone including this oil jetty project will stimulate the economic growth over the region and would benefit some family businesses like vendors, shopkeepers and motorbike-taxi drivers due to economic spill over effects. The project will expand the fuel retail sale and distribution network that will also create more job opportunities such as oil-truck drivers and oil-vessel crews. Therefore the employment and positive economic opportunity related impacts are expected and it can be a positive but indirect impact.

- **Nature of impact:** Positive, direct and indirect impact
- **Duration of impact:** Long-term
- **Extent of impact:** Local
- **Intensity of impact:** Medium
- **Mitigation measures:** NA

5.6.2 Impacts on Health and Safety

A fire hazard is one of the main causes of the potential accidents on duty while handling and storage of the petroleum products. As a fire hazard can cause serious health and safety risks for the workers on site, health and safety aspects have been considered in the project design. Physical contact with petroleum products especially gasoline and inhalation of that fuel vapour is regarded as occupational exposure. The impacts of sewage and solid waste are another concern related to public health.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** The health and safety awareness should be kept throughout the all-time of plant operation
- **Extent of impact:** Local
- **Intensity of impact:** Depend on type and scale of the problem arises
- **Mitigation measures:** The control system for this engineering is a SCADA system. This system will perform data acquisition, central control, interlock control and process flow auto switch during oil tank farm operation, and realize functions

of storage metering, incoming/outgoing/balance management, etc. In fire fighting cabinet, an independent fire fighting PLC system will be installed to be used for fire alarming and fire fighting interlock control. The system must be SIL II certificated on safety. By redundancy communication, this system will share data with the SCADA in the central control room. This project will have a central control room in the tank farm, and a control room in the jetty fire fighting control building at the end of the trestle. In this tank farm room, all data that of transmission and storage system, sewage treatment system, boiler room, fire fighting system and jetty process parameters will come into SCADA and allow for integrated operation, display and management. In the control room of the jetty fire fighting control building, SCADA will gather the pressure transmitted and combustible gas alarm signals, allowing the operators to monitor parameters of the pressure on the spot and combustible gas concentration in the control room, and transmitting the signals through the communication interface and the cable to the tank farm central control system. A local cabinet room will be set near tank groups and pump sheds. The local cabinet will equipped with I/P components for SCADA system transmission and storage control stations, remote I/O, surge protector, etc and will share data with the SCADA system in the central control room by means of redundancy communication. In storage area, combustible gas detectors will be installed according to combustible gas leakage distribution. The instrument on site may be mainly electrical instruments. Except for switching signal and thermal resistance signal, other signals will be of 4 – 20 mA. All electric instruments shall be explosive proofing. The cables which include flame retardant copper core PVC insulated shielded control cable, fluoroplastics flame retardant multi-core control cable for fire control and single-mode fibre optic cable for communication will be mainly laid along the cable racks, and at some parts may be laid in steel tube on ground or buried.

If possible ENCA would like to suggest the owner and/or manager of the oil tank farm to consider getting ISO certification that can provide the best practice of precaution measure relating to safety. On the other hand, appropriate measures should be arranged for the assurance of occupational health and safety such as health and safety trainings, first aid and emergency treatments, and medical facility including the provision of adequate personal protection equipment such as helmet, safety glasses, safety boots, safety belt, ear plugs etc. Management of sewage and solid should be treated as discussed in section 5.5.2 – impact on health and safety and section 5.6.4 – impact on water quality.

5.6.3 Impact on Air Quality

Regarding deterioration of air quality at the project site mainly two types of source can be identified. The first one is the cause of hydrocarbons vapour normally released by the fuel delivery because of the displacement of liquid on the gaseous mixture especially in the gasoline tanks and the evaporation of leaking and spilling fuel. Like other hydrocarbon solvents, gasoline has anaesthetic (narcotic) properties. It contains a number of potentially neurotoxic chemicals including n-hexane, benzene, butadiene, toluene, ethyl benzene, xylene and trimenthyl pentane.

The second one is the cause of emission of exhaust gas from the marine engines, oil-trucks and emergency electricity supply generators installed. Combustion of fossil fuels produces harmful emission of particulate matter (PM), ozone, nitrogen oxide (NO_x), sulphur oxide (SO_x), carbon monoxide (CO) in the air, which can compromise human health. A 520 kW diesel engine mounted generator will be used for the emergency electricity supply according to the project design. The estimated one hour exhaust

emission of this diesel engine may contain 1.82 kg of carbon monoxide (CO), 3.33 kg of Non Methane Hydrocarbon + Nitrogen oxides (NMHC + NO_x) and 0.1 kg of Particulate Matter (PM), according to USEPA Tier 2 emission standards. Lead (as Tetraethyl Lead: TEL) has been identified as the principal component of gasoline responsible for neurological deficits in the past. However, European legislation has prohibited the use of TEL in producing gasoline since January 2000.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** Long term (throughout the project lifetime)
- **Extent of impact:** Isolated
- **Intensity of impact:** it can be low under the proper designing arrangement
- **Mitigation measures:** In the internal floating roof design chosen for all gasoline/gasoil storage tanks of this project, the floating roof consists of floats on the top of the liquid. Depending on the change of vapour pressure inside the tank, these float can play up and down movements. The floating roof is raised up and the air above the float is displaced while the fuel is pumped into the tank. Thus the float automatically adjusts the vapour pressure inside the tank and prevents vapour losses to outside air. Vapour can also be released while loading of oil-trucks and oil vessels.Terminal operators shall wear proper Personal Protective Equipment (PPE).The project should take more care over import quality of gasoline/gasoil; that meaning that only unleaded gasoline shall be imported.

5.6.4 Impacts on Water Quality

As discussed in the previous section, there is a permeable geologic formation at the depth of 0 – 20 m. The fluctuated tide level of Yangon River has influence over the groundwater of this layer. In these conditions, Yangon River can receive inflow of contaminated water from surface and groundwater sources at the project location. The project operation may release living sewage, oily sewage and fire fighting emergency sewage. These are the potential source of impact on water quality. It is designed that the contaminated oil form oil sewage and fire fighting sewage will be removed first and then this sewage will be combined with living sewage to pass into a common sewage treatment system.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** Long term (throughout the project lifetime)
- **Extent of impact:** Isolated
- **Intensity of impact:** It can be low under the proper designing arrangement.
- **Mitigation measures:** Sewage treatment system is considered as a major design aspect of this project. A treatment system with a capacity of 30 tons per hour and 720 tons a day has been chose for this project. The system includes the sewage collection tank, inclined plate of oil removal device, integrated float treatment, biochemical treatment, filter, ozone inactivation treatment. This final treated waste water shall comply with local as well as internationally accepted standards before releasing at designated area that can be over the plantation area and/or to the main drainage line connected to Yangon River. In accordance with Yangon Port Authority, all potential pollutants, hazardous materials, petroleum products, lubricants, hydraulic oil, paints and coatings shall be stored in an approved container and placed/ dispose at designated locations.

5.6.5 Impacts on Noise Level

It is assumed that noise impact will be negligible during the operation. Noise will be generated by the oil delivery pumps, the air compressors; the diesel engine mounted emergency generator, the deliver oil trucks and oil vessels in the jetty place.

- **Nature of impact:** Negative but negligible; direct impact
- **Duration of impact:** Long term (throughout the project lifetime)
- **Extent of impact:** Isolated
- **Intensity of impact:** Negligible
- **Mitigation measure:** NA

5.6.6 Impacts on Traffic and Transport

As Thilawa Industrial Zone has been properly designed, the potential impact related to traffic and transport during operation phase is thought to be insignificant. The volume of traffic will be on the increase due to the daily operational movements of oil-trucks and various types of business vehicles on the Yangon – Thanlyin main road and the movement of unloading and loading oil-vessels in the Yangon River.

- **Nature of impact:** Negative and direct impact
- **Duration of impact:** Temporary (but also intermittent)
- **Extent of impact:** Isolated
- **Intensity of impact:** Low
- **Mitigation measures:** There has been a plan to develop Yangon River. The renovation of the main road between the Thilawa Port Zone and Yangon was in program during the assessment survey. To minimize traffic accidents and traffic congestion, the contractor or someone on his behalf should liaise with the relevant traffic authority that road safety and traffic flow is under control and the movement of vehicles and transporters is under proper schedules which could avoid peak hours.

5.6.7 Impacts on Biodiversity

According to the biodiversity survey, no significant species occurs in this area. Therefore the impact on the biodiversity of this area will be minimal.

- **Nature of impact:** Negative and direct and cumulative
- **Duration of impact:** Permanent nature but not relevant
- **Extent of impact:** Isolated
- **Intensity of impact:** Minimal
- **Mitigation measure:** NA

5.6.8 Cumulative Impact

Actually, the project site occupies less than 0.5 percent of the total area of the overall zone that includes Special Industrial Zone, Local Industrial Zone, Singapore-Myanmar Development Industrial Zone, Sea Ports and Container Yard and Special Economic Zone.

Literally, the analysis of cumulative impacts takes an ecological approach focussing the physical, chemical and biological elements of the ecosystem, particularly in relation with circulation and siltation, water quality, sediment, aquatic and benthic communities and mangrove forests. Population and economic growth, industrial growth, increase of port and shipping business, land reclamation, water disposal and aquaculture are some of the sources of cumulative environmental impacts.

A particular concern is the impact on Yangon River and its downstream as well as upstream mangrove and connected intertidal coastal environment, which is mainly caused by the drain water released from the wastewater treatment systems of various types of anticipated projects under the Thilawa Industrial Zone development scheme. Increased solid sewage and trash will cause soil and water pollution as well as health issues.

- **Mitigation Measures:** It is widely accepted that the understanding and assessing of cumulative impacts is a challenge and therefore mitigating measure of such impacts may be even more challenging and complex. An emerging approach is that the cumulative impacts should be mitigated through an integrated coastal/terrestrial management system (ICM) which is similar to the regional program for the prevention and management of intertidal marine environment. Most importantly, economic development efforts and environmental protection measure should be addressed as simultaneous tasks.

5.6.9 Potential Disaster, Risks and Hazards

The proposed project has designed to share – of its storage capacity for Diesel and the rest - for Gasoline out of total volume of 10268×10^4. Gasoline is a volatile and flammable under certain conditions. The flashing point of gasoline is less than 28°C while the diesel is greater than 55°C meaning that it is less flammable. A study paper of "Storage tank accidents by James I. Changa & Cheng-Chung Lin "pointed out that 74% of a total of242 accidents of storage tank occurred in petroleum refineries, oil terminals or storage tanks. Fire and explosion account for 85% of the accidents. Regarding the cause of accident, lightning stands on the top of the list with 80 accidents (i.e. 33%). Other causes in the descending order are: 13% by maintenance/hot work, 12% by operational error, 8% by equipment failure, 7% by sabotage, 7% by crack/rupture, 6% by leaks and line rupture, 3% by static electricity, 3% by open flame, another 3% by natural disaster, and 2% by the runaway reaction. The followings discussions points are adapted from this study paper.

- Two types of lightning related fires can be classified. The first one is a direct strike and the second is the secondary effects such as the bound charge, the electromagnetic pulse, the electrostatic pulse and the earth currents (Carpenter, 1996).
- About one half of maintenance error happened during the welding works.
- 15 out of 29 accidents by operational error are due to overfilling. 90% of such overfilling leads to fire and explosion.

- Sabotage is the fourth frequent cause. There were 15 cases of terrorist attacks or military operations, 1 case of arson, and 3 cases of theft.
- Among equipment failure, there were 11 cases of sunken-roof, 4 cases of valve failure, 2-heater malfunctions, 1 analyzer failure, and 1 thermostat failure.
- Age deterioration, corrosion and seismic motions attribute crack and rupture.
- 12 tank accidents were caused by static electricity. 6 occurred during the sampling of storage tanks containing flammable liquids at the open access ports.
- 15 accidents were due to leak and line rupturing.
- Open flames such as ground fires and cigarette smoking etc. caused 8 accidents
- 7 accidents were due to natural disaster/earth quake. Fortunately, only 4 earthquakes resulted catastrophic oil spill or fire. Among the 4 accidents, 3 occurred in Japan and one in Turkey.
- Exothermic runaway reactions may occur when impurities or foreign materials are present in the storage tanks; five accidents were recorded.

Mitigation measure: The proposed project has already introduced possible protection measures in its engineering design and production functions so that potential impact related disaster risks and hazards are minimized. Following the "Code for design of petroleum depots" and the "Design code for protection of structures against lightning"

Most buildings and structures in the tank farm are in explosive hazardous area, with lightning protection classification of Grade 2. The lightning protection classification of the remaining buildings is Grade 3. Dome roof tank has well thickness of greater than 4 mm, no lightning tod is installed on it, and the tank body is used as lighting receiver directly. Floating roof tank is not equipped with lighting rod, and has the roof and tank body electrically connected with tow conduction wires. Process pump shed is of Grade 2, with lightning protection grid installed on its roof to avoid direct lighting impact. The remaining buildings are of Grade 3. Conductive wire from roof to ground should be not less than two wires.

Surge protector is installed at inlet wire of power distribution unit.

In the tank farm, grounding system uses TN-S system. Equipotential connector box and local equipotential connector box is installed near power inlet wire of buildings and structures. The tank farm uses shared grounding device, equipotential grounding network is grids not larger than 25 m × 25 m, and the grounding resistance is less than 1 Ω.

Static grounding shall be done to all metal pipes and brackets. Static grounding and lightning grounding shall be done to oil pipelines at heads and ends, branches, points after every 200 – 300 m on straight section and inside of boundary. Grounding resistance shall be less than 100 Ω. In case the space between parallel pipes is less than 100 mm, cross wires shall be installed in every 20 m. In case pipelines crossover each other and net distance is less than 100 mm, cross wires shall be installed, and connected to grounding bus in every 50 m at maximum. For cable racks, grounding shall be done in every 20 – 30 m.

In tank farm, grounding electrode vertically insert into ground. Grounding bus wire is buried. Grounding bus wire shall be protected by steel tube when crossing road. Static electrical protection grounding and grounding cross wire use braided soft copper wire, grounding test wells are set in the grounding grid of the tank farm.

In consideration of natural disaster, the engineering design and calculation has constantly followed the design seismic parameter of 8 degree seismic fortification intensity and 0.3 g seismic acceleration.

Regarding fire risk, according to the project design and project layout plan, *Fire Separation Distance* between oil storage tank to tank, tank to facility building, building to building are well defined and qualified by the "Article 6.05 of GB50074-2002: Code of design on building fire protection and prevention". Fire risks can be minimized through implementation of buffer zones. At present, no issue related to buffer zone with neighbouring projects has been described. ENCA strongly advise all contractors to work together in adding buffer zones between each projects. All adjacent institutions should apply the same fire safety standard at the minimum and there should be a controlled fire safety standard for the future placement of facilities around the proposed project site.

The project involves a water storage tank each having a storage capacity of $400m^3$, which will assure the availability of sufficient water for fire fighting purpose. All tank-farm's employees must be given intensive fire fighting training. Fire fighting drills will be scheduled in consultation with the guidance of external fire fighting experts and/or agencies. Attention on housekeeping, such as the removal of flammable materials including rubbish, dry vegetation, and hydrocarbon-soaked soil, should be ascertained by an ethical minded officer that could change behaviours of employees resulting in positive hygienic and safe living practices.

The operations of a bulk fuel storage facility can cause serious health and safety risks to workers on site. Occupational exposures are normally related to the dermal contact with fuels and inhalation of fuel vapours during handling of such products. For this reason adequate measures must be brought in place to ensure safety of staff on site, and includes:

- Proper training of operators;
- First aid treatment;
- Medical assistance;
- Emergency treatment;
- Prevention of inhalation of fumes;
- Provide Personal Protective Equipment (PPE); Protective clothing, footwear, gloves and belts; safety goggles and shields;
- Manuals and training regarding the correct handling of materials and packages should be in place and updated as new or updated material safety data sheets becomes available; and
- Monitoring should be carried out on a regular basis, including accident reports.

6 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) provides management options to ensure impacts of the proposed development are minimised. The EMP is to take pro-active action by addressing potential problems before they occur. This should limit the corrective measures needed, although additional mitigation measures might be included if necessary. The EMP acts as a stand-alone document, which can be used during the various phases (construction and operational) of the proposed bulk fuel storage facility. All contractors and sub-contractors taking part in the construction of the facility should be made aware of the contents of the EMP, so as to plan the relevant activities accordingly in an environmentally sound manner. An EMP for the construction and operational phases of the proposed bulk fuel storage facility has been developed and is available as a separate document. The objectives of the EMP are:

- to include all components of the development;
- to prescribe the best practicable control methods to lessen the environmental impacts associated with the construction of the development;
- to monitor and audit the performance of construction personnel in applying such controls; and
- to ensure that appropriate environmental training is provided to responsible construction personnel.

Once the facility has been constructed, it is highly recommended that the oil tank farm should implement an ISO 14001(or other) Environmental Management System (EMS). An EMS is an internationally recognized and certified management system that will ensure on-going incorporation of environmental constraints. At the heart of an ISO 14001 EMS is the concept of continual improvement of environmental performance with resulting increases in operational efficiency, financial savings and reduction in environmental, health and safety risks. An effective EMS would need to include the following elements:

- A stated environmental policy which sets the desired level of environmental performance;
- An environmental legal register;
- An institutional structure which sets out the responsibility, authority, lines of communication and resources needed to implement the EMS;
- Identification of environmental, safety and health training needs;
- An environmental program(s) stipulating environmental objectives and targets to be met, and work instructions and controls to be applied in order to achieve compliance with the environmental policy; and
- Periodic (internal and external) audits and reviews of environmental performance and the effectiveness of the EMS.

The EMP should focus on the relevant environmental factors for the proposed/existing development, and these should be agreed in consultation with the Environment Protection Unit and relevant public and government agencies.

The following table documents environmental factors, objectives and EPA requirements.

Table 7 Environmental Factors and EPA Requirements

Factors	EPA Objective(s)	EPA Requirements
Noise Management		
Noise/Vibration	Protect the amenity of nearby residents from noise/vibration impacts resulting from activities associated with the proposed/existing development by ensuring that noise/vibration levels meet statutory requirements and acceptable standards.	Identification of sources of noise/vibration and estimates of project-wide noise. Ensure that noise and vibration levels meet acceptable standards and that an adequate level of service, safety and public amenity is maintained. Propose measures to manage and/or mitigate impacts.
Water Management		
Surface water quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected.	Details of site drainage, hydrocarbon use, disposal of plant site waste (including sewage), dewatering, and fate of water used/pumped. Incorporate measures and/or operating procedures to ensure that stormwater run-off from the site reflects patterns, volumes and quality that exist prior to development as far as reasonably practicable. Drainage lines are to be naturalised as much as possible and should enhance the ecological values and recreational opportunities. Propose measures to manage and/or mitigate impacts.
Groundwater quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected.	Describe water requirements for any on-site processing. Incorporate measures and/or operating procedures, which will minimise the demand of the development on potable water supplies. Propose measures to manage and/or mitigate impacts, including over-abstraction.
Waste Water Management		
Wastewater reuse	To protect the aquatic ecosystems, reduce the demand on potable water supplies and prevent off -stream diversions by reusing treated wastewater on site.	Describe potential wastewater reuse schemes for the site. Ensure that no contaminated water, including that containing sediments, leaves the site. Propose measures to manage and/or mitigate impacts.
Air Management		
Air	Ensure that potential air pollutants are contained and that activities do not impact on the natural environment.	Identify sources of air pollution. Propose measures to manage and/or mitigate impacts.
Particulates/Dust	Ensure that particulate/dust emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health	Identification of sources of particulates/dust and estimates of project-wide emissions. Propose measures to manage and/or mitigate

Factors	EPA Objective(s)	EPA Requirements
	problem.	impacts.
Odour	Ensure that operations do not generate odour that causes environmental nuisance.	Identification of sources of odour and estimates of project-wide emissions. Propose measures to manage and/or mitigate impacts.
Waste Management		
Solid/liquid waste	Ensure that wastes are contained and isolated from land, ground and surface water surrounds and treatment or collection does not result in long-term impacts on the natural environment.	Identify sources of solid and liquid waste and estimate the proposed amount generated. Propose measures to manage and/or mitigate impacts.
Special waste	Ensure that wastes are contained and isolated from land, ground and surface water surrounds and treatment or collection does not result in long-term impacts on the natural environment.	Identify the source of special waste and estimate the amount generated. Propose measures to manage and/or mitigate impacts.
Contaminated Land		
Land	Ensure that existing or proposed activities do not discharge to land.	Identify activities that have the potential to discharge to land. Propose measures to manage and/or mitigate impacts.
Surface water	Ensure that existing or proposed activities do not discharge to surface waters.	Identify activities that have the potential to discharge to surface waters. Propose measures to manage and/or mitigate impacts.
Groundwater	Ensure that existing or proposed activities do not discharge to groundwater.	Identify activities that have the potential to discharge to groundwater. Propose measures to manage and/or mitigate impacts.
Hazardous Materials Management		
Scheduled wastes	Ensure scheduled wastes are specially treated for their destruction.	Identify scheduled wastes and describe treatment of their destruction. Propose measures to manage and/or mitigate impacts.
Resource storage	Ensure that chemicals and other potentially harmful resources used in the manufacturing process are stored and disposed of correctly.	Describe the use and management of chemicals and other potentially harmful resources. Propose measures to manage and/or mitigate impacts.
Pest control	Ensure that pest control chemicals are used safely and appropriately.	Describe the use and management of pest control chemicals. Propose measures to manage and/or mitigate impacts.
Household chemicals	Ensure residual household chemicals are disposed of in accordance with guidelines.	Describe the use and management of household chemicals. Propose measures to manage and/or mitigate

Factors	EPA Objective(s)	EPA Requirements
		impacts.
Compressed/liquid gas	Ensure the suitable storage of compressed/liquid gas.	Describe the use and management of compressed/liquid gas. Propose measures to manage and/or mitigate impacts.
Compressed/liquid gas	Ensure the suitable storage of compressed/liquid gas.	Describe the use and management of compressed/liquid gas. Propose measures to manage and/or mitigate impacts.

Refer to relevant Environment Protection Policy for guidance on meeting the requirements of the Act and Regulation.
These factors should be addressed within the EMP document.
Further environmental factors may be identified during the preparation of the EMP, therefore on-going consultation with the Environment Protection Unit and other relevant agencies is recommended.

7 PAYMENT FOR ECOSYSTEM SERVICES

Ecosystem services have no standardized definition but might broadly be called the benefits of nature to households, communities, and economies" or,more simply, "the good things nature provides. "Ecosystem services are the benefits that people receive from nature—for example, the production of food, the provision of clean water, and the regulation of climates, as well as opportunities for cultural, spiritual and recreational experiences." "Ecosystem services underpin our very existence. Despite this, they are consistently undervalued in economic analyses and decision-making. As a result, many services are in decline, along with the biodiversity that supports them. Measuring and monitoring ecosystem services can lead to better environmental planning, enhancing sustainability and human well-being."

As mentioned earlier, there would be a minimal loss of ecosystem services provided by the single site. The project is only referred to a very small sector of the whole storage facility. However, when the whole area is developed, loss of ecosystem services would be probably large. Each and every project should leave a reasonable amount of fund to be effective payment for ecosystem services.

An Integrated Environmental Management Plan of each block should be formed by the Environment Management Plan to work out a plan of how to provide funds as payments for ecosystem services. They should develop and deploy a rapid assessment tool to understand how far conserving sites for their biodiversity importance also helps to conserve different Ecosystem Services, relative to a converted state.

By that way, they would be able to estimate difference between current state and plausible alternatives. They should identify stakeholders consisting of conservationists, local communities and developer and engage them through meetings, community workshops, providing assistance with the work, reporting back results and consulting for interpretation. They then should consider the distribution of benefits between different groups which would be worked out between social status level of poverty, gender etc.

Toolkit for measuring and monitoring ecosystem services at site scale is still at its pilot stage but will be available by the time this development has been approved and construction works stated.

It has been informed that Puma Energy Thilawa Terminal Co., Ltd, on its part, would set aside a fund amounting US$ 75,000 as a Payment of Ecosystem Service PES. ENCA strongly suggest other developers to achieve an environmentally sound and sustainable development.

8 CONCLUSION AND RECOMMENDATIONS

In general, the proposed bulk fuel storage facility would pose limited environmental and social risks. The proposed bulk fuel storage facility would contribute to the economy of local area and the region by creating jobs and diversifying the economic activity.

The site is generally suitable for the proposed bulk fuel storage facility. All environmental risks can be minimised and managed through implementing preventative measures and sound management systems. It is recommended that environmental performance be monitored regularly to ensure compliance and that corrective measures be taken if necessary. It is also recommended that this information be made available to the Community at a regular basis.

Fire prevention should be adequate, as specified by the SANS 10089 standards.

Health and safety regulations should be adhered to in accordance with the Regulations pertaining to Health and Safety.

The Environmental Management Plan should be used as an on-site reference document during all phases (Planning, Construction and Operation) of the proposed bulk fuel storage facility, and auditing should take place in order to determine compliance with the EMP. Parties responsible for transgression of the EMP should be held responsible for any rehabilitation that may need to be undertaken.

With future expansion of the proposed bulk fuel storage facility, compliance with environmental, health and safety issues must again be checked and improved where necessary during an EIA.

Any polluted soil or groundwater encountered during the baseline survey and during the construction process must be reported to the relevant authorities and the contaminated soil and or groundwater must then be disposedof in an applicable manner.

REFERENCES

- ADB; Environmental assessment guidelines, 2003
- Aqua Bound Col Ltd, U Win Latt; The role of Myanmar's environment related laws and regulations in protection and management of costal marine ecosystems' issues and needs.
- Atiq Sediqi, Advisor to the Afghan Ministry of Mines; A preliminary assessment of air quality in Kabul, amsediqi@sbcglobal.net.
- BANCA; Interim report of EIA on Thilawa oil storage facitity, March 2012.
- BRC Research Report No. 8, Bangkok Research Center; Newly emerging industrial development nodes in Myanmar: ports, roads, industrial zones along economic corridors by Aung Min and Toshihiro Kudo, 2012.
- Buncefield Major Incident Investigation Board; Recommendations on the design and operation of fuel storage sites, March 2007.
- Department of Meteorology and Hydrology – Myanmar; Adaptation to climate change in Myanmar, DMH, Myanmar, www.moezla.gov.mm
- Egyptian Environmental Affairs Agency (EEAA); Environmental impact assessment guidelines for oil and gas sector, January 2005.
- ELSEVIER; A study of storage tank accidents by James I. Chang, Cheng-Ehung Lin, May 2005.
- ELSEVIER; Cumulative environmental impacts and integrated costal management, the case of Xiamen, China, March 2004.
- Geo Pollution Technologies Pty. Ltd; Environmental impact assessment for a proposed bulk fuel storage facility for Namcor, Walvis Bay, Namibia, January 2008.
- Health Protection Agency; Petrol-toxicological overview by RP Chilcott, 2007
- Myanmar Business Network; Business plan 2010 for developing a new SEZ in Myanmar to attract overseas investors, www.myanmar-business.org
- NGO Forum on ADB; Advocacy guide to ADB EIA requirement, December 2006
- Petrojam Limited; EIA, Petrojam refinery upgrade project, Jamaica, April 2009
- Southeast Asia Petroleum Engineering Co. Ltd; Project proposal for 100,000 cubic meter refined oil tank farm, in Yangon, Myanmar, April 2011.
- Thai Environmental Regulation; Noise and Vibration Standards, www.pcd.go.th/indexEng.cfm.
- UNEP; Environmental management in oil and gas exploration and production – an overview of issues and management approaches, 1997.
- USAID; Environmental assessment of the USAID/Haiti north park power project, June 2011.
- WHO Regional Office for Europe; Night noise guidelines for Europe, 2009.

WHO; Guidelines for community noise by Birgitta Gerglund, Thomas Lindvall and Dietrich H Schwela, 1999.

ANNEX I

Monthly average meteorological characteristics values of Yangon, Kabs-Aye Meteorological Station (2005-2008)

Average air pressure (hPa)	1014.4	1012.9	1011.1	1010.0	1007.9	1007.0	1007.6	1008.2	1009.1	1011.4	1053.0	1014.1	1013.9
Daily maximum air pressure (hPa)	1022.5	1019.6	1020.4	1016.5	1213.3	1011.9	1014.3	1014.1	1014.5	1017.0	1019.6	1019.5	1213.3
Daily minimum air pressure (hPa)	1008.1	1005.7	1005.2	1001.8	992.4	1000.6	1001.3	999.0	1003.0	1004.0	1006.1	1008.4	992.4
Average air temperature (˚C)	24.7	26.5	28.8	30.0	27.7	26.5	25.7	26.1	26.3	27.5	27.1	24.8	26.8
Average maximum air temperature (˚C)	33.5	35.7	37.3	37.3	33.1	31.1	30.2	30.3	30.6	33.0	34.1	33.1	33.3
Average minimum air temperature (˚C)	15.8	17.3	20.3	22.7	22.4	21.9	21.2	21.8	21.9	21.9	20.0	16.4	20.3
Daily maximum air temperature (˚C)	36.5	40.8	39.9	40.5	41.0	39.4	34.5	34.0	36.2	37.2	38.0	38.2	41.0
Daily minimum air temperature (˚C)	11.8	13.3	15.5	18.0	19.0	18.4	17.7	18.3	18.6	19.0	15.0	11.0	11.0
Average precipitation (mm)	4.6	4.4	17.2	98.5	489.4	477.8	709.6	515.4	534.8	188.2	16.0	18.8	3074.7
Daily maximum precipitation (mm)	5.0	6.0	39.0	123.0	344.0	99.0	170.0	92.0	243.0	97.0	11.0	42.0	344.0

Average evaporation capacity (mm)	3.5	4.2	5.1	5.2	3.2	2.2	2.2	2.2	2.5	3.0	3.6	3.4	40.3
Average relative humidity (%)	73	67	67	68	85	91	93	93	92	86	78	73	80
Minimum relative humidity (%)	51	42	44	42	53	77	70	71	72	68	50	55	42
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Average vapor pressure (hPa)	24.0	24.9	27.9	30.9	31.9	32.9	32.1	32.3	32.5	32.8	28.9	24.0	29.6
Average wind speed (m/s)	0.6	0.6	0.8	0.8	1.0	0.9	0.9	0.8	0.8	0.6	0.7	0.7	0.8
Daily maximum wind speed (m/s0	3.2	4.3	4.8	4.3	42.9	4.3	3.2	4.3	4.8	3.8	4.3	4.3	42.9
Wind direction	NE	E	E	SW	VIR	SW	SW	SW	E	E	E, SE	E	VIR
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rainy day (d)	0	0	1	4	17	24	26	24	21	11	2	1	130
Thunderstorm days (d)	0	0	1	6	12	12	5	6	6	9	1	0	59
Foggy days (d)	9	4	3	0	0	0	0	0	1	2	1	2	22

Monthly average meteorological characteristics values of Yangon, Kabs-Aye Meteorological Station (2005-2008)

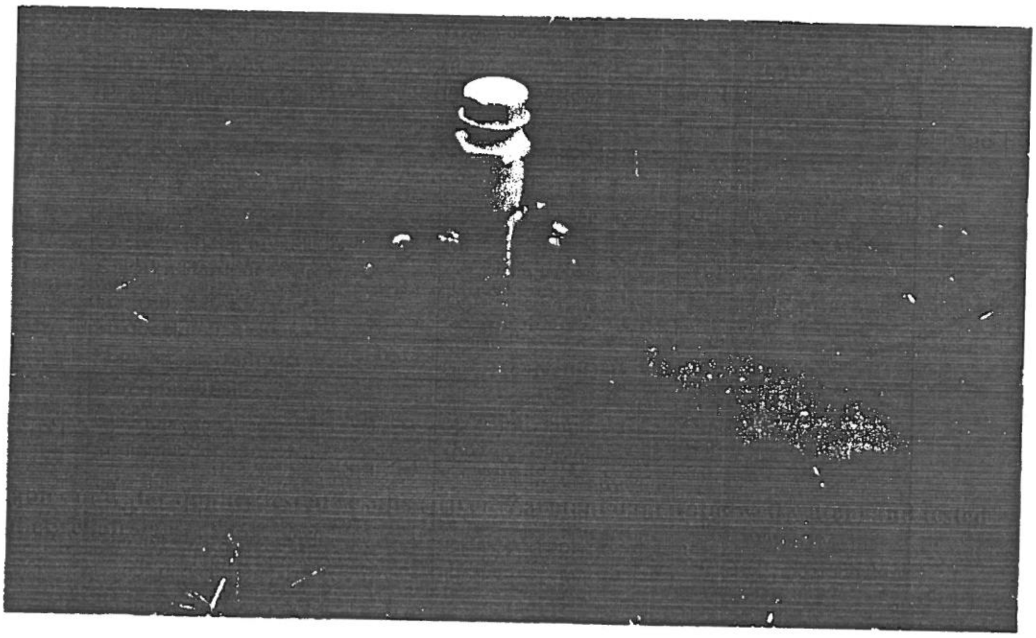
Maximum Temperature (˚C)	32.3	34.8	33.7	36.5	33	31.7	31.2	30.5	31.2	33	31.9	33.3
Minimum Temperature (˚C)	18.2	19.5	21.6	24.4	24.7	24.7	24	23.7	23.6	23.5	21.4	19.7
Mean Temperature (˚C)	25.25	27.15	27.65	30.45	28.85	28.2	27.6	27.1	27.4	28.25	26.65	26.5
Wind Speed (mph) at 09:30 MST	1.5	1.7	2.1	1.4	1.7	2	1.6	3.4	1.8	1.7	1.4	2.2
Wind Speed (mph) at 18:30 MST	1.6	1.6	2.4	1.9	1.9	1.4	1.5	1.7	1.8	1.4	1.1	1.2

Maximum Rainfall Data

Maximum Rainfall (inch)	6	3.75	5.92	4.15	3.5	6.25	6.2	4.6	4.6	7.21
Minimum Rainfall (inch)	0.05	0.02	0.04	0.01	0.03	0.05	0.06	0.03	0.03	0.04

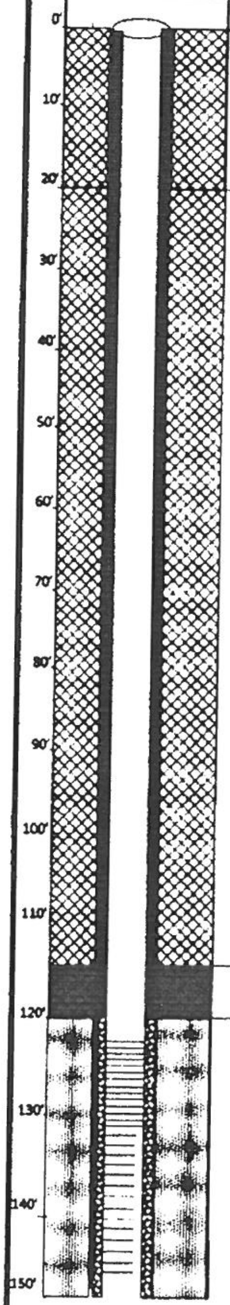
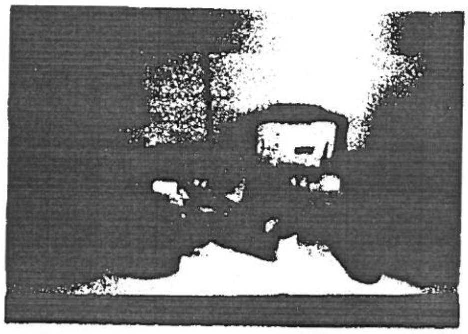
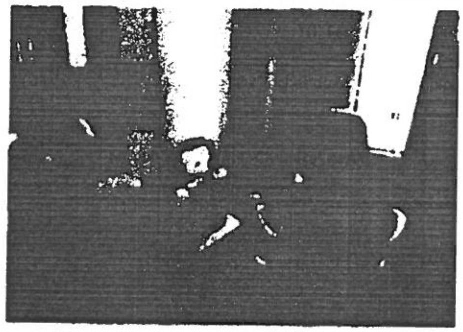
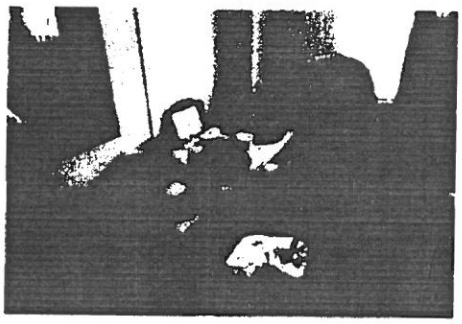
ANNEX 2

Tables of water quality tested results (River, Zarmani dam, tube-well water) and tested tube-well design



Tube well

Location	:	Thilawar SEZ	Total Depth	:	154 Feet
Township	:	Thalyin	Screen Setting	:	30' Feet
Date Started	:	20.7.2013	Water Level	:	10' Feet
Date Completed	:	20.7.2013	G.P.S Point	:	
Water Capacity of Pumping out Test	:	1200 Gallons per Hour.	Casing	:	Ø2"inches diameter casing pipe

Depth (Ft)	Lithology & Well Design	Lithology Description	Site photo & Water Chemical Result
0'–150'			  
0'–20'		Clayey SILT Yellowish to Grey	
20'–115'		Clayey SILT Bluish Light Grey Colour	
115'–120'		Silty SAND Bluish Light Grey	
120'–150'		SAND Light Grey Colour	

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Client	ENCA	**Tube Well No**	
Address	Thilawa SEZ ,	**Analysis NO**	MYP- 018/13
	Thanlyin Township	**Sampling Date**	22.7.2013
Purpose	Industrial & Domestic used	**Received Date**	23.7.2013
		Analysis Date	23.7.2013

WATER QUALITY TEST & ANALYSIS RESULT

Sr. No.	TEST ITEMS	G.W.H- 1		WHO Guideline
1	pH Value	7.30		6.5-8.5
2	Turbidity	56	NTU	5 NTU
3	Colour	10	TCU	15 TCU
4	Conductivity	15670	micro S/cm	
5	Total Hardness	2000	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
6	Total Alkalinity	214	mg/l as $CaCO_3$	
7	Phenolphthalein Alkalinity	Nil		
8	Calcium Hardness	1414	mg/l as $CaCO_3$	
9	Iron (Fe)	1.58	mg/l	0.3 mg/l
10	Magnesium Hardness	586	mg/l as $CaCO_3$	
11	Manganese (Mn)	Nil		0.05
12	Carbonate ($CaCO_3$)	Nil		
13	Chloride (as CL)	6650	mg/l	250
14	Sodium chloride(as NaCL)	10973	mg/l	
15	Bicarbonate (HCO_3)	214	mg/l as $CaCO_3$	
16	Sulphate (as SO_4)	520	mg/l	200
17	Salinity	9.1	ppt	
18	Total Solids	8950	mg/l	1500
19	Suspended Solids	130	mg/l	
20	Dissolved Solids	8820	mg/l	1000
21	Phenolphtthalein Acidity	2	mg/l	

Tested by: Khin

Checked by : Thandar
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Client	ENCA	Tube Well No	
Address	Thilawa SEZ ,	Analysis NO	MYP- 018/13
	Thanlyin Township	Sampling Date	22.7.2013
Purpose	Industrial & Domestic used	Received Date	23.7.2013
		Analysis Date	23.7.2013

WATER QUALITY TEST & ANALYSIS RESULT

Sr. No.	TEST ITEMS	G.W.H- 1	WHO Guideline
22	Methyl Orange Acidity	Nil mg/l	
23	Lead (as Pb)	Nil mg/l	0.01 mg/l
24	Fluoride	Nil mg/l	1.5 mg/l
25	Arsenic	Nil mg/l	0.01 mg/l
26	Temperature (°C)	25	
27	Chlorine (Residual)	Nil	
28	Chemical Oxygen Demand(COD)	288 mg/l	
29	Biochemical Oxygen Demand(BOD)	115 mg/l	
30	Dissolve Oxygen (DO)	4.20 mg/l	
31	Total Solids		
32	Suspended Solids		
33	Dissolve Oxygen (DO)		
34	Nitrate (NO_3- N)	Nil	
35	Ammonia Nitrogen(NH_3)	Nil	
36	Ammonium Nitrogen (NH_4)	Nil	

Tested by: Khin
Khin May Than
B.Sc (Geology)
Engineering Geologist
Myayarpin Co.,Ltd.

Checked by : THANDAR
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WATER QUALITY TEST RESULTS FORM

(W)A - 0208

Client: BANCA
Nature of Water: Station - 1
Location: Thilawa Port Expansion
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Phosphate	Nil	mg/l	
pH			6.5 - 8.5
Colour (True)	40	TCU	15 TCU
Turbidity	110	NTU	5 NTU
Conductivity	124	micro S/cm	
Total Hardness	48	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	52	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness	30	mg/l as $CaCO_3$	
Iron	6.00	mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)	10	mg/l	250 mg/l
Sodium chloride (as NaCL)	17	mg/l	
Bicarbonate (HCO_3)	52	mg/l as $CaCO_3$	
Sulphate (as SO_4)	10	mg/l	200 mg/l
Total Solids	190	mg/l	1500 mg/l
Suspended Solids	131	mg/l	
Dissolved Solids	59	mg/l	1000 mg/l
Phenolphthalein Acidity	2	mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature: Hein
Name: Zaw Hein Oo
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Chemist
ISO TECH Laboratory

(a division of WEG Limited)

Approved by
Signature:
Name: Win Myint
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WATER QUALITY TEST RESULTS FORM

(W-app:)A - 0208

Client: BANCA

Nature of Water: Station - 1

Location: Thilawa Port Expansion

Date and Time of collection: 18.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 23.10.2012

Date and Time of Completing: 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)		mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate (N.NO_3)		mg/l	50 mg/l
Chlorine (Residual)	Nil	mg/l	
Ammonia (NH_3)	0.24	mg/l	
Ammonium (NH_4)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	320	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20°C)	128	mg/l	

Tested by

Signature: ____

Name: Zaw Hein Oo
~~B.Sc (Chemistry)~~
Chemist
ISO TECH Laboratory

Approved by

Signature: ____

Name: Win Myint
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(A.T)A - 0208

WATER QUALITY TEST RESULTS FORM

Client: BANCA
Nature of Water: Station - 1
Location: Thilawa Port Expension
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 28.10.2012

Results of Filter Analysis

	Raw	Aeration အဝေါ်ရေစင်ကြည်	Aeration Filter
Iron (mg/l)	6.00	4.50	2.86
pH	6.5	6.8	7.1

Tested by

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Name: Zaw Hein Oo
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WATER QUALITY TEST RESULTS FORM

(W)A - 0205

Client: BANCA
Nature of Water: Station - 1 (a)
Location: Thilawa Port Expansion
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 25.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Phosphate	Nil	mg/l	
pH			6.5 - 8.5
Colour (True)	90	TCU	15 TCU
Turbidity	635	NTU	5 NTU
Conductivity	128	micro S/cm	
Total Hardness	56	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	52	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness	36	mg/l as $CaCO_3$	
Iron	10.20	mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)		mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids		mg/l	
Dissolved Solids		mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature: [signature]
Name: Zaw Htein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

(a division of WEG Limited)

Approved by
Signature: [signature]
Name: Win Myint
~~B.E (Civil) 1980, M.MES~~
Technical Officer
ISO TECH Laboratory

ISO TECH
LABORATORY
Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001,
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WATER QUALITY TEST RESULTS FORM

(W-app:)A - 0205

Client: BANCA
Nature of Water: Station - 1 (a)
Location: Thilawa Port Expansion
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 25.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)	°C	
Fluoride (F)	mg/l	1.5 mg/l
Lead (as Pb)	Nil mg/l	0.01 mg/l
Arsenic (As)	Nil mg/l	0.01 mg/l
Nitrate ($N.NO_3$)	mg/l	50 mg/l
Chlorine (Residual)	mg/l	
Ammonia (NH_3)	mg/l	
Ammonium (NH_4)	mg/l	
Dissolved Oxygen (DO)	mg/l	
Chemical Oxygen Demand (COD)	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20°C)	mg/l	

Tested by
Signature: Hein
Name: Zaw Hein Oo
~~B.Sc (Chemistry)~~
Chemist
ISO TECH Laboratory

Approved by
Signature:
Name: Win Myint
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WATER QUALITY TEST RESULTS FORM

(W)A - 0209

Client: BANCA
Nature of Water: Station - 2
Location: Thilawa Port Expansion
Date and Time of collection: 19.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Phosphate	Nil	mg/l	
pH			6.5 - 8.5
Colour (True)	50	TCU	15 TCU
Turbidity	128	NTU	5 NTU
Conductivity	114	micro S/cm	
Total Hardness	50	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	52	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness	32	mg/l as $CaCO_3$	
Iron	6.60	mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)	10	mg/l	250 mg/l
Sodium chloride (as NaCL)	17	mg/l	
Bicarbonate (HCO_3)	52	mg/l as $CaCO_3$	
Sulphate (as SO_4)	10	mg/l	200 mg/l
Total Solids	220	mg/l	1500 mg/l
Suspended Solids	166	mg/l	
Dissolved Solids	54	mg/l	1000 mg/l
Phenolphthalein Acidity	2	mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
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Name: Zaw Hein Oo
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Chemist
ISO TECH Laboratory

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Approved by
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WATER QUALITY TEST RESULTS FORM

(W-app:)A - 0209

Client ________ BANCA

Nature of Water ________ Station - 2

Location ________ Thilawa Port Expansion

Date and Time of collection ________ 19.10.2012

Date and Time of arrival at Laboratory ________ 22.10.2012

Date and Time of Commencing examination ________ 23.10.2012

Date and Time of Completing ________ 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline

(Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)		mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate ($N.NO_3$)		mg/l	50 mg/l
Chlorine (Residual)	Nil	mg/l	
Ammonia (NH_3)	0.30	mg/l	
Ammonium (NH_4)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	352	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20°C)	176	mg/l	

Tested by

Signature: ________

Name: Zaw Hein Oo
~~B.Sc (Chemistry)~~
Chemist
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Approved by

Signature: ________

Name: Win Myint
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WATER QUALITY TEST RESULTS FORM

(W)A - 0206

Client: BANCA
Nature of Water: Station - 2 (a)
Location: Thilawa Port Expansion
Date and Time of collection: 19.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 25.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Parameter	Result	Unit	WHO Guideline
Phosphate	Nil	mg/l	
pH			6.5 - 8.5
Colour (True)	70	TCU	15 TCU
Turbidity	288	NTU	5 NTU
Conductivity	107	micro S/cm	
Total Hardness	44	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	52	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness	28	mg/l as $CaCO_3$	
Iron	8.00	mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)		mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids		mg/l	
Dissolved Solids		mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature: Hein
Name: Zaw Hein Oo
~~B.Sc (Chemistry)~~
Chemist
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Signature:
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WATER QUALITY TEST RESULTS FORM

(W-app:)A - 0206

Client: BANCA
Nature of Water: Station - 2 (a)
Location: Thilawa Port Expansion
Date and Time of collection: 19.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 25.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)	°C	
Fluoride (F)	mg/l	1.5 mg/l
Lead (as Pb)	Nil mg/l	0.01 mg/l
Arsenic (As)	Nil mg/l	0.01 mg/l
Nitrate (N.NO_3)	mg/l	50 mg/l
Chlorine (Residual)	mg/l	
Ammonia (NH_3)	mg/l	
Ammonium (NH_4)	mg/l	
Dissolved Oxygen (DO)	mg/l	
Chemical Oxygen Demand (COD)	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20°C)	mg/l	

Tested by
Signature: Hein
Name: Zaw Hein Oo
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Approved by
Signature:
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WATER QUALITY TEST RESULTS FORM (W)A - 0211

Client: BANCA
Nature of Water: Za Ma Ni Inn Dam
Location: Thilawa Port Expansion
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Phosphate	Nil	mg/l	
pH			6.5 - 8.5
Colour (True)	Nil	TCU	15 TCU
Turbidity	10	NTU	5 NTU
Conductivity	42	micro S/cm	
Total Hardness	16	mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity	18	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness	10	mg/l as $CaCO_3$	
Iron	0.56	mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)	7	mg/l	250 mg/l
Sodium chloride (as NaCL)	12	mg/l	
Bicarbonate (HCO_3)	18	mg/l as $CaCO_3$	
Sulphate (as SO_4)	Nil	mg/l	200 mg/l
Total Solids	37	mg/l	1500 mg/l
Suspended Solids	18	mg/l	
Dissolved Solids	19	mg/l	1000 mg/l
Phenolphthalein Acidity	2	mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature: Heini
Name: Zaw Hein Oo
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Chemist
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Approved by
Signature:
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WATER QUALITY TEST RESULTS FORM

(W-app:)A - 0211

Client: BANCA

Nature of Water: Za Ma Ni Inn Dam

Location: Thilawa Port Expansion

Date and Time of collection: 18.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 23.10.2012

Date and Time of Completing: 28.10.2012

Results of Water Analysis

WHO Drinking Water Guideline (Geneva - 1993)

Temperature (°C)		°C	
Fluoride (F)		mg/l	1.5 mg/l
Lead (as Pb)	Nil	mg/l	0.01 mg/l
Arsenic (As)	Nil	mg/l	0.01 mg/l
Nitrate (N.NO$_3$)		mg/l	50 mg/l
Chlorine (Residual)	Nil	mg/l	
Ammonia (NH$_3$)	0.30	mg/l	
Ammonium (NH$_4$)		mg/l	
Dissolved Oxygen (DO)		mg/l	
Chemical Oxygen Demand (COD)	40	mg/l	
Biochemical Oxygen Demand (BOD) (5 days at 20°C)	16	mg/l	

Tested by

Signature: Hein

Name: Zaw Hein Oo
~~B.Sc (Chemistry)~~
Chemist
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Signature:

Name: Win Myint
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(A.T)A - 0211

WATER QUALITY TEST RESULTS FORM

Client: BANCA
Nature of Water: Za Ma Ni Inn Dam
Location: Thilawa Port Expansion
Date and Time of collection: 18.10.2012
Date and Time of arrival at Laboratory: 22.10.2012
Date and Time of Commencing examination: 23.10.2012
Date and Time of Completing: 26.10.2012

Results of Filter Analysis

	Raw	Aeration ထပေါ်ရည်ကြည်	Aeration Filter
Iron (mg/l)	0.56	0.40	0.22
pH	7.2	7.4	7.6

Tested by

Signature: Hein

Name: Zaw Hein Oo
B.Sc (Chemistry)
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Signature:

Name: Win Myint
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ANNEX 3

Flora Survey

Introduction

Plants are a cornerstone of the foundations of life in ecosystems. Thought of as "producers," plants capture light energy radiated from the sun and convert it into the sugars and starches that other organisms consume for energy. In addition to producing energy, plants convert raw materials present in the ecosystem such as carbon from the atmosphere andinorganic
minerals and compounds fromthe soil including nitrogen,potassium, and iron and make these elemental nutrients available to other life forms. From the simplest plants, such as algae, to towering forest trees such as Oaks, plants provide food and habitat. Plant communities provide shelter, cycle nutrients, and protect water quality. Plants make oxygen.

Plants are the only thing that are able to convert the suns energy into food and in the process convert the carbon dioxide that animals make eating each other and plants back into oxygen.

Usually, they provide a near-base for the food chain, since they use energy from the sun to perform photosynthesis, which is then passed on to herbivores, and so on and so forth. Also, when they rot and or die, they provide some fertilizer for the soil, enriching it.

Plants are producers, they take the energy emitted from the sun and turn it into simple sugars, which are then turned into ATP (Adenosine Triphosphate, energy usable by the plant and animals) through cellular respiration, other animals then eat them and receive ten percent of the energy contained in the plant, also known as the ten percent rule.

Participants

The team comprises of 3 members.

1) U Than Lwin (Technical officer)
2) Ye Lin Aung
3) Than Swe Oo

Materials and Methods

Vegetation was investigated along the ShwePyauk stream and two transect lines and the species of trees and shrubs identified and recorded.

Materials used

- Digital camera for photographic documentation
- GPS(Garmin 60Csx) for locating coordinates
- Field note book
- Cutter

Sample Plotting

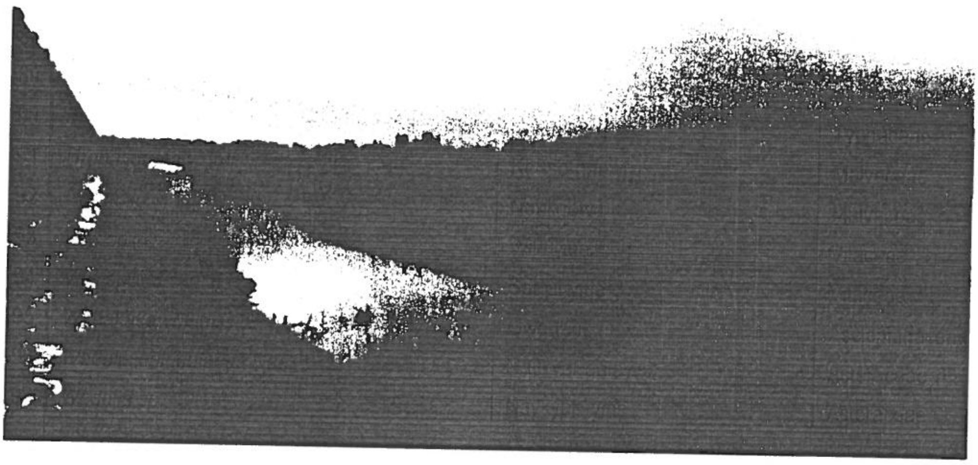
Sample plotting was not carried out because the vegetation in the surveyed area was scatteredand scarce. Transect survey method was used to explore shrubs, herbs, water plants and mangroves existing at this survey site.

Plants species recorded from survey area

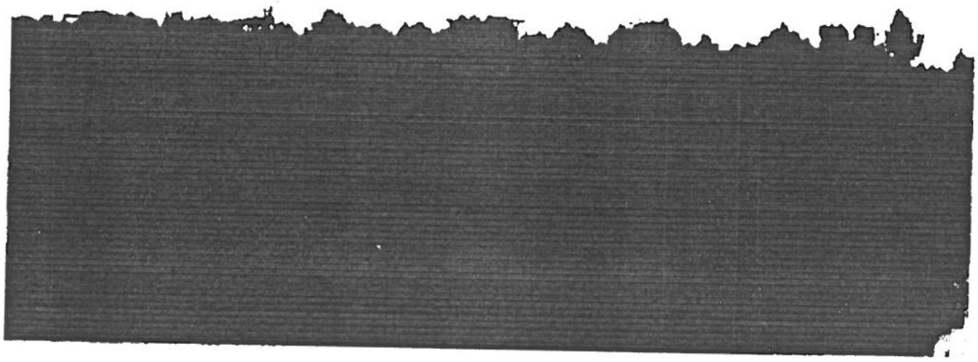
No.	Scientific Name	Vernacular Name	Family
1	*Acanthus ilicifolius L.*	Kha-yar	Acanthaceae
2	*Achyranthes aspera L.*	Kyet-mauk-sue-pyan	Amaranthaceae
3	*Acrostichum speciosum*	Nget kyi taung	Pteridaceae
4	*Albizia lebbek (L.) Benth*	Kalr kokko	Mimosaceae
5	*Albizia procera (Roxb).*Benth	Sit	Mimosaceae
6	*Alocasia macrorrhizos* G.Don	Pein	Araceae
7	*Alternanthera sessilis L.*	Wild ka-na-phaw(pazun-sar)	Amaranthaceae
8	*Alysicarpus vaginalis (L.)DC*	Than-manaing-kyauk-manaing	Fabaceae
9	*Amaranths spinosus L.*	Hnin Nu New subuk	Amaranthaceae
10	*Anlternanthera nodiflora R.Br.*	Kanaphaw yine	Amaranthaceae
11	*Arunbo donax L*	Kyu	Poaceae
12	*Avicennia officinalis*	Lame	Avicenniaceae
13	*Calamus viminalis Willd.*	Kyein-kha	Arecaceae
14	*Calotropis gigantea (L.)* Dryand.ex w.,T.Aiton	Mayoe	Asclepiadaceae
15	*Carallia brachiata (Lour.)Merr*	Maniawga	Rhizophoraceae
16	*Cassytha filiformis* L.	Shwe new	Lauraceaae
17	*Ceiba pentandra Gaertn.*	Thinbaw- letpen	Bombacaceae
18	*Celeome burmanii* Wight& Arn.	Taw hnin galar	Capparaceae
19	*Cephalandra indica Naud*	Kinmon	Cucurbitaceae
20	*Cleome burmanii Wight & Arn*	Tawhingalar	Capparaceae
21	*Cleome viscosa L.*	Tawhingalar yine	Capparaceae
22	*Clerodendrum inerme Gaertn.f.*	Pin -le kyaukpan	Verbenaceae
23	*Clerodendrum macrosiphon* Hook.F.	Ngayan-padu	Verbenaceae
24	*Clerodendrum serratum Spreng*	Yin-bya	Verbenaceae
25	*Commelina nudiflora*	Myet kyut	Commelinaceae
26	*Corchorus aestuans L.*	Pi law yin	Tiliaceae
27	*Costus speciosus Sm.*	Pha-lan-taung-hmwe	Costaceae
28	*Croton oblongifolia Roxb.*	Thetyin-gyi	Euphorbiaceae
29	*Cynodon dactylon Pers.*	Myay-sar-myet	Poaceae
30	*Cyperus compressus L.*	Wetlar-myet	Cyperaceae
31	*Dalbergia foliacea Wall.*	Daungtalaung	Fabaceae
32	*Dalbergia spinosa Roxb*	Byaik	Fabaceae
33	*Derris trifoliata Lour*	Migyaung-pan	Fabaceae
34	*Dioscorea sativa L.*	Myauk u	Dioscoreaceae
35	*Echinochloa colona Link.*	Be-sar-myet	Poaceae
36	*Eclipa alba (L.) Hassk*	Kyeik hman	Esteraceae
37	*Ehcoecaria agallocha L.*	Thayaw	Euphorbiaceae
38	*Eichhornia crasssipes(Mart.)Solms*	Bae-dar	Pontederiaceae
39	*Eriolaena candollei Wall*	Tayaw	Sterculiaceae
40	*Erythrina fusca Lour*	Kon ka thit	Fabaceae
41	*Erythrina lithosperma Blume*	Ye-kathit	Fabaceae

No.	Scientific Name	Vernacular Name	Family
42	*Eupatorium lindleyanium*	Bizat	Asteraceae
43	*Ficus racemosa*	Thaphan	Moraceae
44	*Ficus religiosa L.*	Bawdi nyaung	Moraceae
45	*Glochidon sp.*	Htamasoke	Euphorbiaceae
46	*Hibiscus ficulneus L.*	Taw-yonpadei	Malvaceae
47	*Hibiscus tiliaceus L.*	Thin-ban	Malvaceae
48	*Hoya burmanica* Rolfe	Khamon	Asclepiadaceae
49	*Hygrophila phlomoides* Nees.	Migyaung-kunbat	Acanthaceae
50	*Indigofera tinctoria L.*	Me-yaing	Fabaceae
51	*Ipomoea aquatic* Forssk	Kazun-ywet	Convolvulaceae
52	*Ipomoea camea Jacq.*	Lathar pan	Convolvulaceae
53	*Ipomoea sagittata Poir*	Kon-kazun	Convolvulaceae
54	*Ipomoea sp.*	Taw kyet- thon	Convolvulaceae
55	*Ipomoea turbinata Lagasca*	Kazun-new	Convolvulaceae
56	*Ixora coccinea L*	Ponnayeik	Rubiaceae
57	*Jussiaea suffruticosa L.*	Tawlay -nyin	Onagraceae
58	*Kaempferia rotunda L.*	Not known	Zingiberaceae
59	*Lannea wodier (Roxb) Adelb*	Nabe	Anacardiaceae
60	*Leucaena leucocephala (Lam.) De Wit*	Bawzagaing	Mimosaceae
61	*Luffa aegyptiaca mill*	Tha-but-khar	Cucurbitaceae
62	*Malachra capitata L.*	Sin-ma-mwe-sok	Malvaceae
63	*Microcos paniculata L.*	Mya-yar	Tiliaceae
64	*Mimosa pudica L.*	Hti-ka-yon	Mimosaceae
65	*Mimosa rubicaulis Lam.*	Japan htikayon	Mimosaceae
66	*Monochoria hastata* Solms	Kadauk sat	Pontederiaceae
67	*Mucuna pruriens*(L)DC	Khwe layar	Fabaceae
68	*Nymphae lotus L.*	Kya-phu	Nymphaceae
69	*Nymphaea rubra Roxb.*	Kyarni	Nymphaceae
70	*Nymphaea stellata Willd*	Kya-pyar	Nymphaceae
71	*Nypa fruticans Wurmb*	Dani	Arecaceae
72	*Ocimum sanctum L.*	Kala-pin sein	Lamiaceae
73	*Oldenlandia sp.*	Not known	Rubiaceae
74	*Operculina tarpetham (L)Silbamansa*	Kyarhninpin	Convolvulaceae
75	*Paspalum flavidum* A.Camus	Sin ngo-myet	Poaceae
76	*Passiflora foetida L*	Taw suka	Passifloraceae
77	*Phyllanthus acidus(L)Skeels*	Taung ziphyu	Euphorbiaceae
78	*Physalis minima* L.	Bauk pin	Solanaceae
79	*Securinega irosa (*Roxb,ex Wild) Bail	Yechin ya	Euphorbiaceae
80	*Senna alata L.*	Pwe say mazali	Caesalpiniaceae
81	*Senna tora (L.) Roxb*	Dan-gywe	Caesalpiniaceae
82	*Sesbania paludosa Roxb*	Nyan	Fabaceae
83	*Sida acuta Burm.*	Ta-byetsi ywet chon	Malvaceae
84	*Sida cordifolia L.*	Ta-byetsi ywet wine	Malvaceae
85	*Sonneratia caseolaris(*L.)Engl	Lamu	Sonneratiaceae

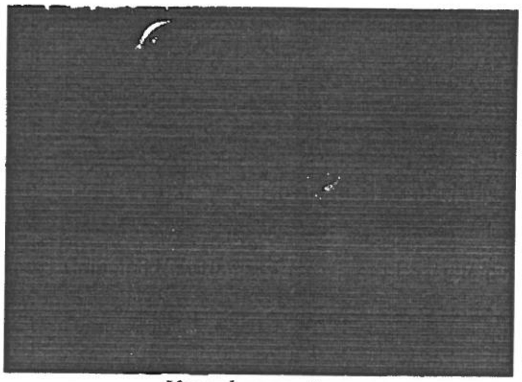
No.	Scientific Name	Vernacular Name	Family
86	*Sonneratia sp.*	Lamae	Sonneratiaceae
87	*Streblus asper Lour.*	Okne	Moraceae
88	*Tadehagi triquetrum* (L.)H.Ohashi	Lauk-thay	Fabaceae
89	*Talipariti tiliaceum* (L.) Fryxell	Thin-pan	Melastomataceae
90	*Typha angustifolia Chaub.&Bory*	Paik-swel	Typhaceae
91	*Urena lobata* L.	Ket-se-nae-gyi	Malvaceae
92	*Urena sp.*	Not known	Malvaceae
93	*Vitis sp.*	Wild vine	Vitaceae
94	*Vitis sp.*	Sapyit yine	Vitaceae
95	*Wattakaka voludilis* (L.f.)Stapf	Gwe-tauk new	Asclepiadaceae
96	*Wedelia calndulacea Nee*	Naykyar galay	Asteraceae
97	*Wedelia sp.*	Naykyar -yine	Asteraceae



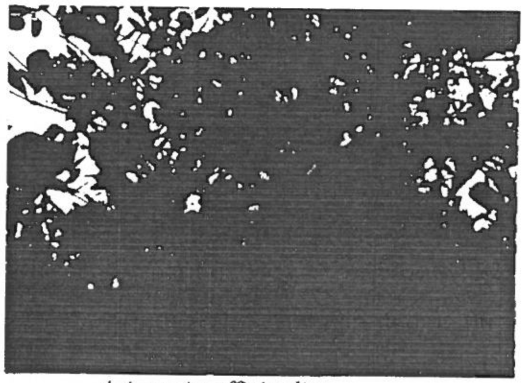
Survey site Plot No. (3)



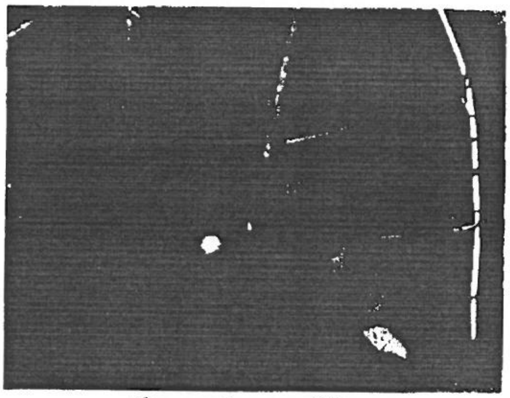
Mangroves forest at river bank



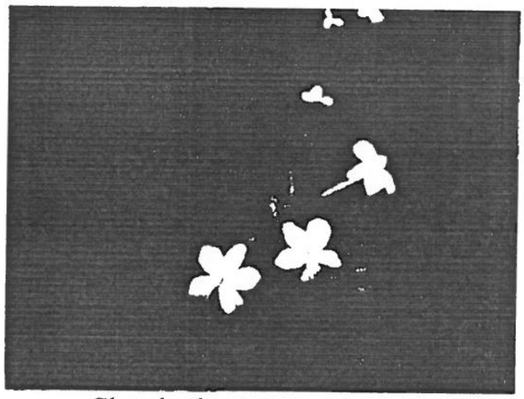
Hoya burmanica



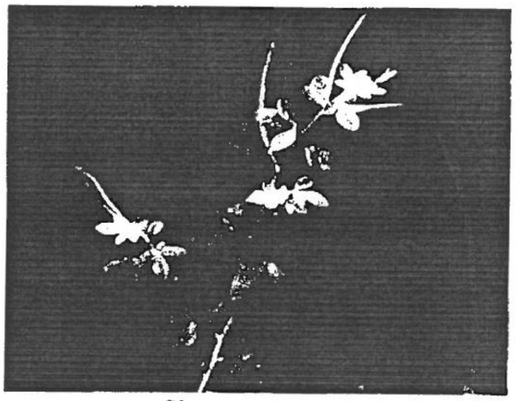
Avicennia officinalis



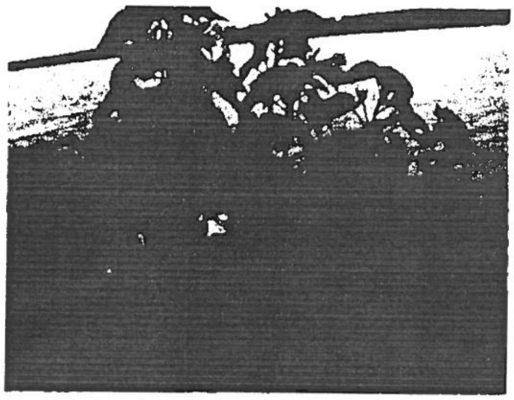
Alternanthera nodiflora



Clerodendrum inerme



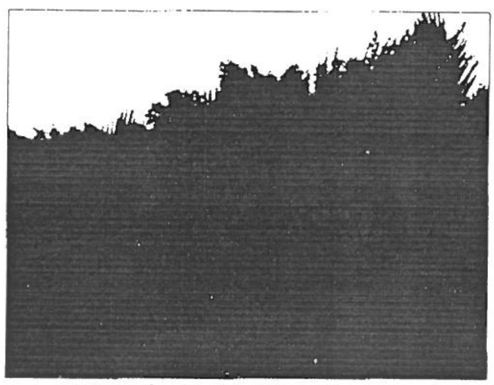
Cleome viscosa L



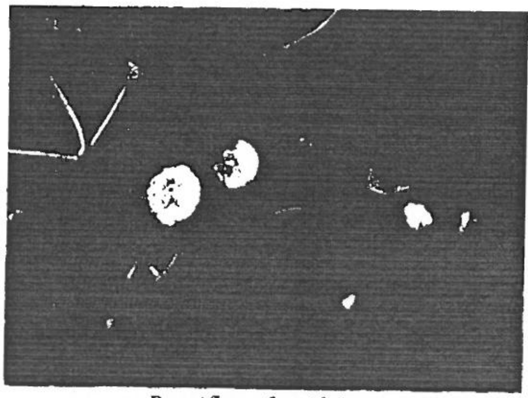
Ipomea carnea Jacq.



Mimosa pudica L



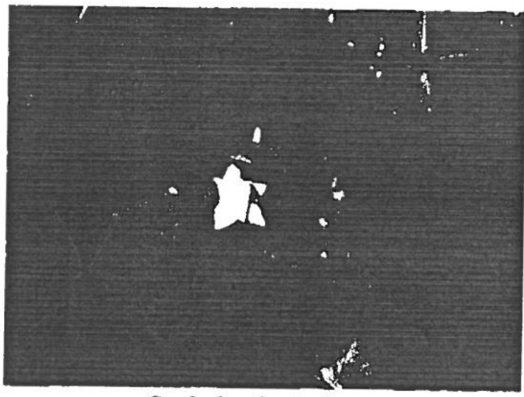
Nypa fruticans Wurmb



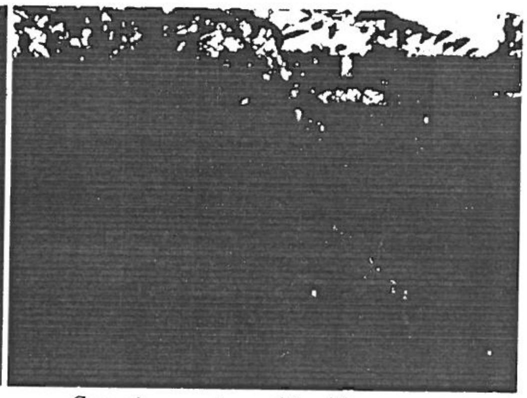
*Passiflora foetida*L.



Eclipta alba (L.)



Cephalandra indica



Securinega virosa (Roxb)

Conclusion

A total of 97 species of trees, shrubs, herbs and climbers were observed .As the area was no longer a primary forest since many decades ago all the tree are actually residual plants.At the western corner of the site at the river bank their still remain a small grove of mangrove trees. All are actually young tree only about three years old. About three years ago these mangroves were cleared for the preparation of the site and all the mangrove found today recently regenerated ones .All these mangrove will be gone when the construction of the jetty commence become.

ANNEX 4

Ornithological Survey

Ornithological Investigation of Thilawa Port (Oil Storage) Project

Ornithological investigation of Thilawa Port (Oil Storage) project was carried out in July 2013 as a part of the Environmental Impact Assessment of that project. The survey period was approximately one week starting from 11th to 16thJuly 2013.

Materials and Methods

The investigation area is located in Kyauk Tan Township, Yangon Region. Myawaddy Trading survey site is situated in Thilawa Industrial Zone.

The port area being in the degraded mangrove forest, open, grass and scrub is clearly not the best area to look out for a good diversity of birds and animals. A few bird calls and songs were heard throughout the whole investigation period of six days.

The ornithological investigation started on the 11th of July 2013 and ended on the 16th of July.

Birds were identified and recorded daily during the survey period.

The ornithological survey always started in the early morning at first light around 06:00. Birds were studied the whole morning till 11:30 and started from 15:00 till dusk. Birds were observed using Nikon 8x42 6.3° (Japan) binoculars and Opticron HDF Zoom (ES 80 GA ED v3) telescope. The pictures were taken by Canon IXUS 210 camera. The coordinates of the study area were also recorded using a Global Positioning System (GARMIN GPS map 60Cx) and bird species were identified in reference to "A Field Guide To The Birds of Thailand And South-East Asia (Craig Robson)."

Participant

Saw Moses

Checklist of birds found in Thilawa area

No	Common New Name	Scientific name	IUCN
1	Lesser Whistling-Duck	*Dendrocygna javanica*	
2	Cotton Pygmy-Goose	*Nettapus coromandelianus*	
3	Little Grebe	*Tachybaptus ruficollis*	
4	Painted Stork	*Mycteria leucocephala*	[redacted]
5	Black-headed Ibis	*Threskiornis melanocephalus*	
6	Yellow Bittern	*Ixobrychus sinesis*	
7	Cinnamon Bittern	*Ixobrychus cinnamomeus*	
8	Black Bittern	*Ixobrychus flavicollis*	
9	Black-crowned Night-Heron	*Nycticorax nycticorax*	
10	Little Heron	*Butorides striata*	
11	Indian Pond-Heron	*Ardeola grayii*	
12	Chinese Pond-Heron	*Ardeola bacchus*	

No	Common New Name	Scientific name	IUCN
13	Eastern Cattle Egret	*Bubulcus coromandus*	
14	Purple Heron	*Ardea purpurea*	
15	Great Egret	*Ardea alba*	
16	Intermediate Egret	*Mesophoyx intermedia*	
17	Little Egret	*Egretta garzetta*	
18	Little Cormorant	*Phalacrorax niger*	
19	Oriental Dater	*Anhinga melanogaster*	
20	Black -shouldered Kite	*Elanus caeruleus*	
21	Red-legged Crake	*Rallina fasciata*	
22	Watercock	*Gallicrex cinerea*	
23	Red-wattled Lapwing	*Vanellus indicus*	
24	Long-billed Plover	*Charadrius placidus*	
25	Greater Sand-Plover	*Charadrius leschenaultii*	
26	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	
27	Bronze-winged Jacana	*Metopidicus indicus*	
28	Eurasian Curlew	*Numenius arquata*	
29	Common Redshank	*Tringa totanus*	
30	Oriental Pratincole	*Glareola maldivarum*	
31	Rock Pigeon	*Columba livia*	
32	Red Collared-Dove	*Streptopelia tranquebarica*	
33	Spotted Dove	*Streptopelia chinensis*	
34	Thick-billed Green-Pigeon	*Treon curvirostra*	
35	Plaintive Cuckoo	*Cacomantis merulimus*	
36	Violet Cuckoo	*Chrysococcyx xanthorhynchus*	
37	Asian Koel	*Eudynamys scolopacaceus*	
38	Greater Coucal	*Centropus sinensis*	
39	Common Barn-Owl	*Tyto alba*	
40	Collared Scops-Owl	*Otus lettia*	
41	Asian Barred Owlet	*Glaucidium cuculoides*	
42	Asian Palm-Swift	*Cypsiurus balas*	
43	House Swft	*Apus affinis*	
44	Indian Roller	*Coracias benghalensis*	
45	White-throated Kingfisher	*Halcyon smymensis*	
46	Black-capped Kingfisher	*Halcyon pileata*	
47	Common Kingfisher	*Alcedo atthis*	
48	Little Green Bee-eater	*Merops orientalis*	
49	Coppersmith Barbet	*Megalaima haemaccephala*	
50	Fulvous-breasted Woodpecker	*Dendrocopos macei*	
51	Ashy Woodswallow	*Artamus fuscus*	
52	Common Iora	*Aegithina tiphia*	
53	White-throated Fantail	*Rhipidura albicollis*	
54	Black Drongo	*Dicrurus macrocercus*	
55	Ashy Drongo	*Dicrurus leucophaeus*	
56	House Crow	*Corvus splendens*	

No	Common New Name	Scientific name	IUCN
57	Large-billed Crow	*Corvus japonensis*	
58	Brown-throated Sunbird	*Anthreptes malacensis*	
59	Olive-backed Sunbird	*Cinnyris jugularis*	
60	Scarlet-backed Flowerpecker	*Dicaeum cruentatum*	
61	Baya Weaver	*Ploceus philippinus*	
62	White-rumped Munia	*Lonchura striata*	
63	Scaly-breasted Munia	*Lonchura punctulata*	
64	Chestnut Munia	*Lonchura atricapilla*	
65	House Sparrow	*Passer domesticus*	
66	Plain-backed Sparrow	*Passer flaveolus*	
67	Eurasian Tree-Sparrow	*Passer montanus*	
68	Paddyfied Pipit	*Anthus rufulus*	
69	Jungle Myna	*Acridotheres fuscus*	
70	Common Myna	*Acridotheres tristis*	
71	Asian Pied Starling	*Gracupica contra*	
72	Chestnut-tailed Starling	*Sturnus malabaricus*	
73	Eastern Stonechat	*Saxicola maurus*	
74	Pied Bushchat	*Saxicola caprata*	
75	Oriental Magpie-Robin	*Copsychus saularis*	
76	Streak-eared Bulbul	*Pycnonotus blanfordi*	
77	Red-whiskered Bulbul	*Pycnonotus jocosus*	
78	Red-vented Bulbul	*Pycnonotus cafer*	
79	Barn Swallow	*Hirundo rustica*	
80	Yellow-eyed Babbler	*Chrysomma sinense*	
81	Chestnut-capped Babbler	*Timalia pileata*	
82	White-throated Babbler	*Turdoides gularis*	
83	Zitting Cisticola	*Cisticola juncidis*	
84	Common Tailordbird	*Orthotomus sutorius*	
85	Grey-breasted Prinia	*Prinia hodgsonii*	
86	Yellow-bellied Prinia	*Prinia flaviventris*	
87	Plain Prinia	*Prinia inornata*	

There were only four near threatened NT and no globally threatened species found in this area.

ANNEX 5

Herpetofauna Survey

Participants

The herpetological studies started from 11th July, 2013 and ended on the 16th of July 2013. The survey team comprised Myint Kyaw Thura and Nay Myo Win.

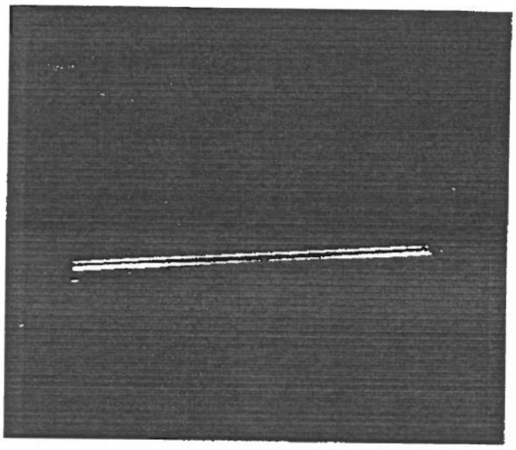
Materials and Methods

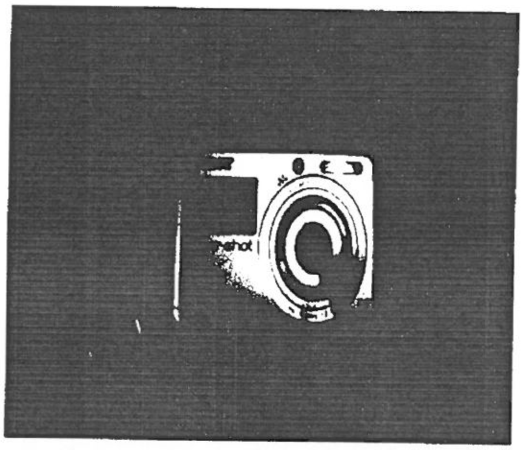
Methods

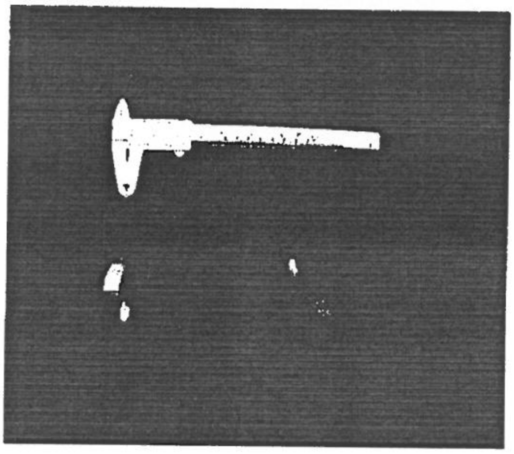
Herpetology team surveyed proposed area in random and surveyed surrounding area to be covered. Surveys were made twice in a day during day and night periods.Reptiles and amphibians were surveyed by direct observation and focused on aquatic micro-habitats. Visual observations, documented when possible by photographs, were made of some captured specimens that were not collected. These included protected species and also species for which large series had already been collected. Wherever possible, animals were captured by hand with the aid of locally made long stick caliper. Latitude and longitude of collected localities were recorded using a Garmin GPS map 60 csx. Photo records were taken by digital camera (SONY S730). Their morphometric characters and measurement of each specimen were recorded such as sizes, shapes, patterns, spots, stripes, color and bodylength in the data sheet. The specimens were measured in the analysis, as snout vent length (SVL), tail length (TL), head length (HL), head width (HW), ventral scale (VS), tail scale (TS), and scale row (SR) were conducted using caliper and measuring tape.Identification was carried out according to below references.

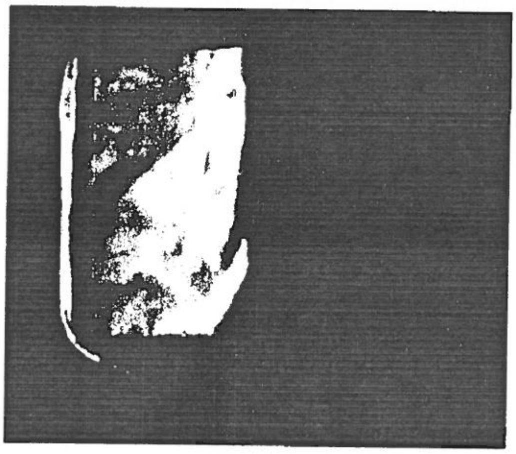
Materials for sample collection

- Long stick clipper to catch snakes made by locally
- Rubber band to shoot lizards and skinks
- Digital camera (SONY S730)
- Garmin GPS map 60 csx
- Caliper and measuring tape
- Plastic and Rubber gloves
- Data forms
- K- Lite torches with alkaline batteries









References

- Anon. 2003. *Key in Progress – Lizards in Myanmar*. Keys\KeyMyanmarLizard.rtf, version:jul 2003. P 1-13.
- Anon. Undated. *Key to the Families: Order Squamata, Suborder Serpentes*. P.1-49.
- BANCA 2006. Report: *Tamanthi dam, hydropower and multipurpose project statement of biodiversity impact (2006) (A rapid assessment)*. 94 pp.
- Cox, M.J., P.P. Dijk, J. Nabhitabhata and K. Thirakhupt. 1998.
- *A Photographic Guide to Snakes and Others Reptiles of Thailand and SouthEast Asia*. Asia Books Co.Ltd., Bangkok. 144 pp..
- Leviton, A.E., J.V. Vindum, M.S.Koo, R.S.Lucas and O.U.Wogan. 2002. *Dangerously Venomous Snakes of Myanmar.Illustrated Checklist with Keys*. California Academy of Science, San Franscisco. 85 pp.
- Win Maung and Win Ko Ko. Myanmar Turtles and tortoise. 2002.
- Zug, G.R. 1997, a. *Preliminary Checklist & Keys to the Amphibians & Reptiles of Myanmar*. Smithsonian Institution, Washington DC.
- Zug, G. R. 1997, b. *Preliminary Keys – Frogs of Myanmar*. Asia-1:\Burma\BKeyFrog.doc; version: sept 1997 – georgezug. 7 pp.

- Zug, G. R. 1997, c. *Preliminary Keys – Turtles of Myanmar.* Asia-1:\Burma\BKeyTurt.doc; version: sept 1997 – georgezug. 5 pp.
- Zug, G. R. 1997, d. *Preliminary Keys – Lizards of Myanmar.* Asia-1:\Burma\BKeyLiz.doc; version: september 1997 – georgezug. 7 pp.
- Zug, G. R. 1997, e. *Preliminary Keys – Snakes of Myanmar.* Asia-1:\Burma\BKeySnk.doc; version: september 1997 – georgezug. 6 pp.

Results

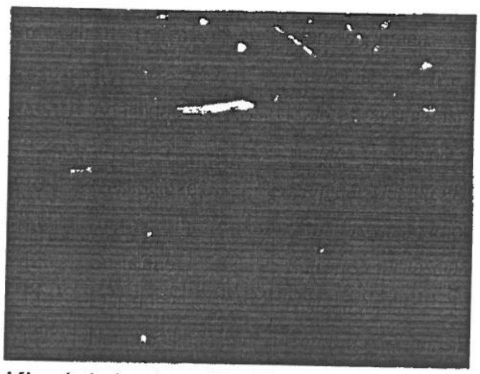
A total of 15 species of herpetofauna comprising 7 species of amphibians belonging to 3 families and 8 species of reptiles belonging to 6 families were observed photographed and recorded.

Herpetofauna checklist collected from Puma Energy Area

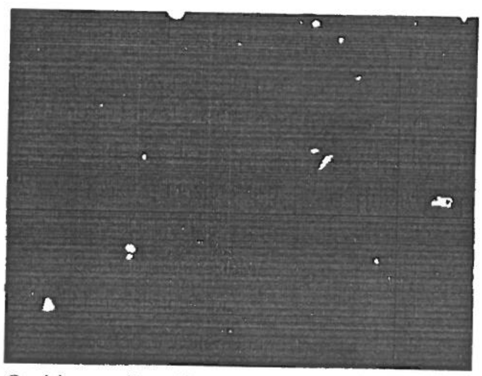
Hepertofauna data list from Thilawa (Puma Energy Myanmar)				
No.	**Family Name**	**Scienticfic Name**	**Common Name**	**Quantity**
1	Bufonidae	*Bufo melanostictus*	Common Toad	2
2	Microhylidae	*Microhlya berdmorei*	Ber Narrow-mouthed Frog	8
3	Ranidae	*Occidozyga lima*	Common Floating Frog	12
4		*Fejervarya limnocharis*	Paddy Frog	7
5		*Fejervarya cf. limnocharis*	Paddy Frog	5
6		*Rana erythraea*	Red-eared Frog	6
7		*Rana macrodactyla*	Long-toed Frog	2
8	Agamidae	*Calotes mystaceus*	Blue Forest Lizard	2
9		*Calotes versicolor*	Garden Lizard	8
10	Gekkonidae	*Hemidactylus brooki*	Brooke's House Gecko	4
11		*Hemidactylus garnotii*	Garnot's Gecko	3
12	Scincidae	*Eutropis multifasciata*	Common Sun Skink	1
13	Elapidae	*Naja kaouthia*	Monocellate Cobra	1
14	Homalopsidae	*Cerberus rynchops*	Dog-faced Water Snake	5
15	Natricidae	*Amphiesma stolatum*	Buff-striped Keelback	1

There were 7 Amphibian and 8 reptilian species found in this area.

According to the conservation status of 2012 IUCN Red list Data, there are no threatened or endemic species in the survey area.



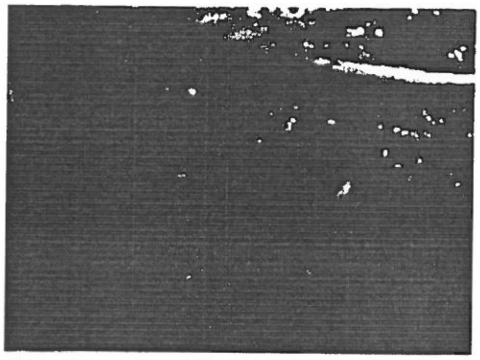
Microhyla berdmoreiBer Narrow-mouthed Frog



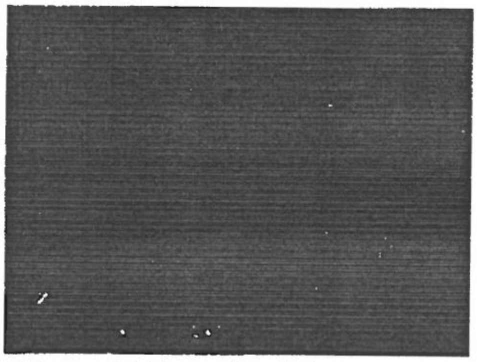
Occidozyga lima Common Floating Frog



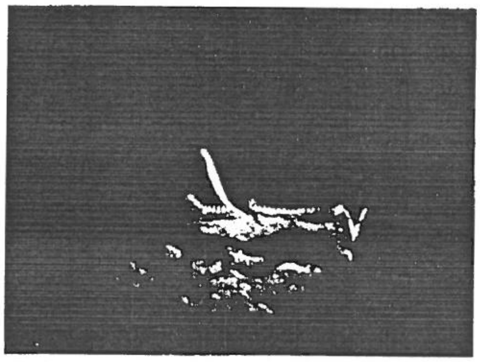
Rana erythraeaRed-eared Frog



Rana macrodactylaLong-toed Frog



Naja kaouthiaMonocellate Cobra



Cerberus rynchopsDog-faced Water Snake

Conclusion

The result of this survey showed no significant findings. Results from previous surveys from the nearby areas also showed no significant records of herpetofauna.

The land itself is not a key biodiversity area (KBA) or a corridor for important species for conservation. The nearest KBA lies approximately 100 kilometres away from the survey site.Therefore it can be concluded that the construction of this storage facility bears a minimal or no impact on herpetofauna species.

ANNEX 6

Mammal Survey

The study team

We have thoroughly investigated this area from 11th to 16th Julyin 2013.The participants were Thida Nyein and Thaw Zin.

Materials and methods

Methods

Field studies were conducted in fields and the construction area. Interview surveys were carried out in local communities in this area.

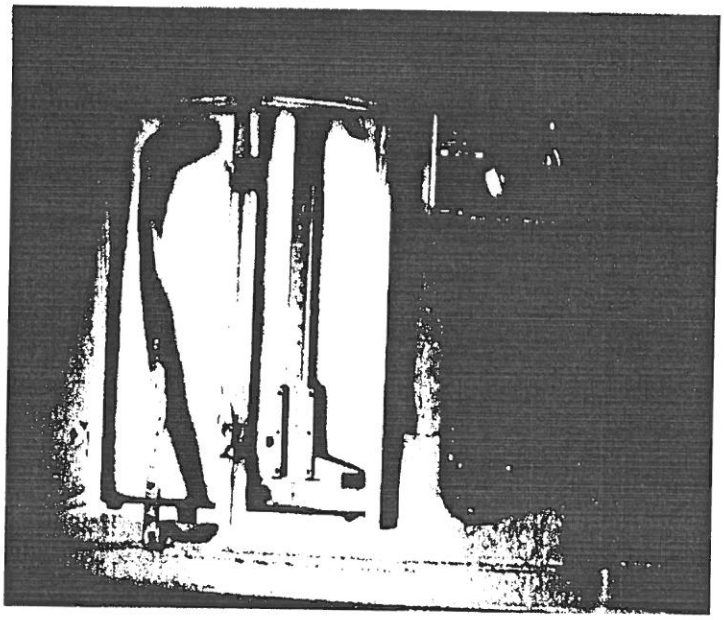
1. **Observation** (with GPS readings), accompanied by written notes and photographs. Different techniques were used to investigate the presence, abundance and habitat use of mammals in the study area. Photographs were taken with Sony Corp 4180473 digital camera. General assessment of vegetation cover and human impacts were also observed.

2. **Specimens,** if there were any, were collected for later identification. Dead animals and their body parts were collected from local people (farmers).
3. **Interviews** with local villagers were used to obtain second hand information about the presence of fauna species in that area.
4. If there were any specimens collected or live animals seen, identification of the taxon was recorded in references to the following field guide books.

Identification was carried out using the references of Tin Than, 2006 "Large Mammals of Myanmar", Tun Yin,1993 "Wild Animals of Myanmar",Francis,C.M.2008 " A Field Guide to the Mammals of Thailand and South-East Asia"

Materials

- GPS locations were recorded using Garmin 60Csx.
- Photographed were made using Sony Corp 4180473 camera.
- Digital clipper and tape measure were used for measurements.

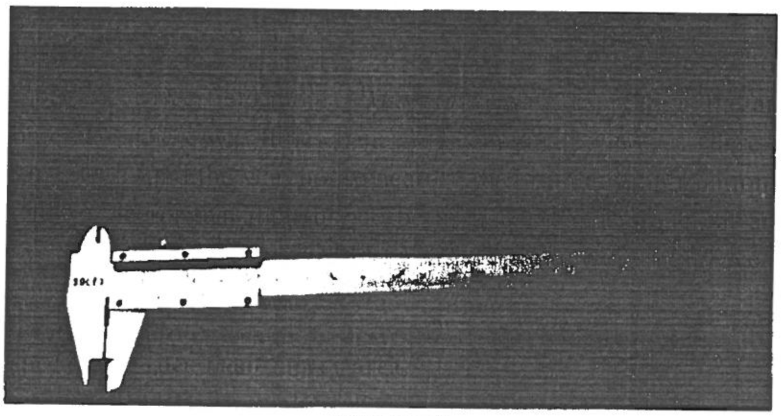


Results

Only one species of rice field mouse, *Mus caroli* was observed as the area was almost totally submerged .There was little chance of seeing many mouse. There could be a few moremice in and around the warehouse nearby. According to information gathered from interview. It was learnt that their use to be mongoose and jungle cat around this area about ten years ago. But we see no chance of these animals to survive in this area as there were no bushes left today.

Mammal species recorded from survey area

No.	Order	Family Name	Scientific Name	Common Name
1	Rodentia	Muridae	*Mus caroli*	Rice field Mouse



Mus coroli

Conclusion

Since this area was cleared since many decades ago for paddy cultivation and there was no primary forest left the impact on mammal was negligible.The only mammal that can survive in this area was rodent.As these rat could move to nearby field easily we see no serious impact on their habitat. As the survey was conducted during the raining season the whole area was flooded.

From interview made from local people on the history of land use it was known that there was no rare or endanger species inhabiting this area before.There is no key biodiversity area within 100km from this site.It could be,therefore, concluded that there is no impact upon mammal because of the use of this site.

ANNEX 7

Aquatic Survey

Report by aquatic team, ENCA (11-7-2013 to 16-7-20130).

Introduction

An environment impact assessment survey was conducted by members of the aquatic team of ENCA from 11-7-2013 to 16-7-2013 at the water of the Yangon River, adjacent to the property land of Puma Energy Co. Survey was also carried out in creek, ponds and ditches in the close vicinity of the company.

A very long stretch of land along the east bank of the Yangon river had been demarcated for the construction of a large modern port complex. At least 37 companies are involved in this large project. A few companies that are situated closer to Yangon city proper are already running the business; many are still in the process of construction work while many have yet to commence foundation work. Puma Energy company is one of the companies that does not yet commence any foundation work. The company is sandwiched between Shwe Daung Co. Ltd; in the north west and Myanmar Integrated Port Limited (MIPL) in the south east.

It is really necessary to conduct such an EIA work given the fact that in the very near future this whole stretch of land along the river bank will be transformed into a huge port complex zone which will, no doubt, have certain impact on the environment of the region. It is also learnt that a huge industrial complex zone will be established adjacent to the port complex.

As environment has become a pressing issue worldwide each and every company that is going to set up in this region should be subjected to EIA survey prior to commencing construction work. Moreover, regular or occasional (yearly or bi -yearly) follow up assessment or monitoring should be continued even after operation.

It is of utmost importance that all infrastructure development should be environmentally checked before implementation. This EIA survey is actually a pre-assessment of the aquatic environment of the area. Actual impact assessment should be conducted after the company is in full operation.

Participants

1) U Saw Han Shein
2) Nyein Chan
3) Aung Myo Lwin

Materials and methods

The aquatic team concentrated its survey work on the expense of water adjacent to the property of the company and also on the shore, creek, ponds and ditches in the close vicinity.

Three work stations were designated in the river at a distance of 100m from the edge of the water during low tide. These 3 stations were designated for the measurement and recording of physical, chemical, geological and biological data. Positions of the stations were recorded with a G.P.S (Garmin GPS, C560x, Taiwan).

Station 1 was 3km upstream of Puma Energy co. just north of Navy Jetty. Station 2 was adjacent to Puma Energy Co; Station 3was 3km downstream of the company near the mouth of Shwe-pyaut-chaung creek.

The physical and chemical parameters such as temperature, salinity, pH, dissolved oxygen, current velocity and water transparency as well as the ambient temperature of air were measured and recorded. The work was done during low tide and high tide period for each station. For logistics purpose a small wooden boat, 8m long, fitted with a 5 H.P engine (China made) was used.

The following instruments were used for measurements :

1. Salinity refractometer and temperature recorder (Sekesui SS31A, Japan) as well as a simple mercury in glass thermometer
2. pH meter (model pH 6011, Taiwan)
3. Oxygen meter, test kit (Aqua. D.O. Thailand)
4. Sechi disc (for transparency)
5. Current meter (local made, a float and calibrated string)

Plankton was collected during both high tide and low tide. Phytoplankton were collected with a standard phytoplankton net (mesh aperture 100m); and zooplankton with a standard zooplankton net (mesh aperture 200m). The mouth diameter and length of both nets were the same, 20cm and 50cm, respectively.

The plankton specimens were preserved in 4-5% formaldehyde solution and detail study was carried out with the aid of a compound microscope (xx3008A, China) in Yangon.

During low tide the geological and biological aspects of the shore were studied. These included measuring the temperature of the soil (soil pH meter was damaged and out of action), type of substrate, width, height and gradient of the bank. The biological aspect included on the spot study of the benthos, especially epifauna.

The vegetation on the shore, such as grasses, mangrove and mangrove associated plants were studied and recorded.

The fish and prawns caught by the local fishermen in the vicinity of the company property were studied. These included fish caught in the Yangon River by drift net as well as fish caught by push net and cast net in creeks and ditches nearby.

In short, the aquatic biodiversity encompassing plank tonic, nektonic and benthic organisms (microscopic as well as macroscopic plants and animals) have been studied and recorded.

Result (Findings)

A generalized table showing the positions of the 3 stations and the physical, chemical and geological data for each station was depicted in Table.1.

Physical and chemical parameters

During the time of survey work at the 3 stations the weather condition was either cloudy or there was light drizzles. The temperature on the whole was relatively low. It was also windy or very windy and the surface water was relatively rough.

During low tide the surface temperature for the three stations ranged from 28C to 29C and the ambient air temperature range from 26C to 28.5C. During high tide the range in

water temperature was between 28C and 28.5C, while the range for air temperature was between 25C and 26.5C.(Degree celsius).

During low tide the pH range from 8.7 to 8.8, while during high tide the range was between 7.9 to 8.8.

The value of the salinity was always 0 ppt (part per thousand) throughout the survey period due to heavy influx of fresh water during such rainy season.

The value of dissolved oxygen ranged from 6.5 to8.0 ppm during low tide while during high tide the range was between 5.5 to7.5ppm.

The transparency value for all three stations was always 0 m due to very turbid condition of the water.

Current velocity during low tide for three stations range from still water to 10m/20 sec and from 10m/15 sec to 10m/13 sec during high tide.

Geological aspect

The substrate of the beach at the three stations was either sandy mud/muddy sand or soft mud (silt). The width of the banks for the three stations ranged from 25m to 70m; the height ranged from 3m to 5m; and the gradients range from 30 to 35 degrees.

Plankton

The mode of plankton collection could be either horizontal or oblique haul depending on the velocity of the current during the towing of the net.

A list of phytoplankton, zooplankton and meroplanktonwas shown in Table.2.

As usual the salinity of the surface water during this time of the year (the monsoon period) is zero regardless of high tide or low tide. One would naturally expect to find only fresh water species at the surface water level. However the plankton taken into the plankton nets consisted of fresh water species as well as brackish water species. The later are euryhaline species that are known to tolerate and withstand 0 ppt salinity for a certain period of up to a few days.

During low tide species of the blue green algae *Microcystis*which are known to be typical freshwater species dominated the phytoplankton. Brackish water species of *Nitzschia*which could thrive in turbid water (*N. sigma*,and two varieties and *N. spectabilis*,and *N. scalaris*) were also very common, and in some cases dominatedall other species. Hardy species of *Coscinodiscus* (such as *C. lacustris, C. lineatus, C. radiatus*)which could tolerate variable salinities and could thrive well in both clear and turbid water were also common to relatively abundant. As species of *Coscinodicus* (except *C. lineatus*) were large diatom they were conspicuous regular members of the phytoplankton. Another conspicuous diatom, *Surirella* species were also common but never in large number.

Typical freshwater planktonic green algae such species of *Spirogyra* and *Closterium* were found during low tide as well as high tide. The beautiful desmidsspecies, *Micrasterias foliacea*, and *M.mahabuleschwarensis* that were very common in clear freshwater ponds and lakes were recorded for the first time in this turbid water. Other species that were recorded for the first time from this area were the diatoms *Gyrosigma peisonis* and *Gomphonema gracile*; the green algae *Closterium dianae*, *Pleurotaenium trabacula*, *Xanthidium antilopeum*, *X. bengalianum* and *Octocanthium convergens* and the protozoan zooplankton *Parundellapellucide* and *Hexalonche sp.*(The identification of the last taxon is not certain yet since it is known that radiolarians are exclusively

marine. For the present purpose it is included in the list of zooplankton). Planktonic crustacean recorded for the first time from this area were the copepod *Diaptomus sp.* and mysids, *Rhopalophthalmus kempi* and *Acanthomysis pelagica.*

A total of 164 species of plankton comprising 97 species and 5 varieties of phytoplankton and 67species and one variety of zooplankton were recorded. In addition 25 kinds or taxa of meroplankton (meroplanktonic larvae of invertebrate) were also recorded.

In a very turbid water environment like that of the Yangon river the biodiversity as well as the biomass of phytoplankton are relatively low to very low. As a consequence the biodiversity and biomass of zooplankton are also low. Fishes in such turbid water habitat, therefore, feed mainly on organic detritus and to a lesser extent, plankton.

Compared with the results of the previous surveys made approximately a year ago from around this area the number of species recorded was relatively low. This does not mean that there is a decrease in the biodiversity. The simple reason is the limited time for plankton study. There was not sufficient time for thorough study of plankton which involves the detail microscopic examination of the samples, which is actually a time consuming job. There is a time limit for the timely submission of the EIA report to meet the dead line set up by the company. If a little more time can be spared there is no doubt that a few more species can be found and added to the list.

Anyway it is really believed that basic and sound information on the occurrence and distribution of plankton in the area can be obtained from this plankton report.

Fish and prawns

The EIA survey coincided with the period of neap tide. All fishing activities were halted during neap tide as it was not feasible to fish during this period. On the first and second days of the trip no fishing boats were seen in the river. On the third day 6 fishing boats were found operating with drift nets for a very limited time .From these boats only three species of fish were observed.

They were:

*Arius sp. (*Nga-yaung-hteik-kwet or Nga-ohn-thee)

Johnius sp. (Nga-byet-kone*)*

Chrysochir aureus (Nga-poke-thin)

The quantity of catch per boat was very small, less than 1kg. The fishermen told us that they could catch more fish during spring tide and that the fishing season was in the post and pre monsoon periods.

During various previous surveys undertaken during the post and pre monsoon months 42 species of fish were recorded from the Yangon River.

Freshwater species as well as brackish water species of fish and prawns were also caught with either push net or cast net from creeks, ponds and ditches. The large majority of fish caught were found to be only small juveniles.

The species observed were:

1. *Mystus gulio* (nga-sin-yaing), juveniles only
2. *Xenentodon cancila* (yay-cho-nga-paung-yoe), juveniles only
3. *Chana striata* (nga-yant), small ones
4. *Oreochromis mosambica* (Tee-larr- pee-yarr), juveniles only

5. *Clarius batrachus* (nga- khu), juveniles only
6. Lates calcarifer (kart-ka-tik), juveniles or small ones only
7. *Rhinomugil sp.* (kart-be-loo), juveniles and small ones
8. *Lutjanus gibbus* (nga-gone or gone-kyarr), juveniles only
9. *Ambassis baculus* (nga-zin-zart), juvenile or small ones,and 10.*Barbus sp.*(nga-kome-ma),small one. Prawns and crabs:

1. *Macrobrachium rosenbergi* (yay-cho-pazun-htoke-gyi)
2. *Penaeus monodon* (puzun-kyarr), small ones,
3. *Metapenaeus conjunctus* (bawt-gyeik)
4. and small prawns including other species of *Macrobrachium* (small types) and species of *Palaemon* or palaemonid prawns (unidentified)
5. *Scylla serrata* and also probably *S. olivecea* (shoont-ga-nann or sarr-ga-nann).

During the various previous surveys the aquatic team had recorded about 15 species of fish from ponds, creeks and ditches).

Benthos

During low tide a quick survey and on the spot identification of the benthos, especially epifauna was made. At the beach adjacent to station 1 where the substrate was sandy mud virtually no epifauna was found (there might be microinfauna beneath the surface).

At the beaches adjacent to station 2 and station 3 the composition of benthos communities were rather similar. Juvenile or miniature adults of mud skippers, probably *Boreophthalmus boardeti* and *Periophthalmus cantonensis* were found moving to and fro. Small crabs (unidentified together with numerous small crab holes) were found. A few large mud crabs mostly *Sesarma intermidia* (chay-shay-ga-nann) were found in very small number .Two species of snails (*Littorina sp.* and other) found on mangrove trees were also recorded.

Environs (shore and near shore area)

The shore at St.1 was already a cleared land and so only grass (local name myet-karr) and herbs could be seen. There were some buildings still in the process of construction and a couple of ware houses.

At the shore of St.2 (Puma Energy Co. property) young plants of residual mangrove were dominated by *Avecinia alba*, *A. marina* (Tha-met), *Sonneratia caseolaris* (la-mu), *S. apetula*(kant-ba-lar) and *Exocaria agollocha* (tha-yaw). There were also a few *Nypa fruticans* (da-neet) and the ever present mangrove bush, *Acanthus ilicifolium* (ka-yar) were found. Two to three species of mangrove associated plants (unidentified) was also found. All there mangrove and associated plants will be cleared when the construction of jetty commence.

At the upper part of the beach luxuriant growth of grass such as *Cyperus* sp. (wet-lar-myet) and unidentified myet-kharr grass were observed. All these will be also gone when the jetty materialize.

At the shore of St.3 (near the mouth of shew-pyauk-chaung creek) quite a large number of mangrove and associated plants were found. As usual the mangrove was dominated by *Avecinia alba*, *A. marina* (Tha-met), *Sonneratia caseolaris* (la-mu), and *S. apetula*(kant-ba-lar). *Ceriops decandron* (ma-da-ma) was also quite common. The

thorny bush, *Dalbergia spinosa* (byaik or byaik-hsoo) and the persistent *Acanthus ilicifo*lium (ka-yar) were also observed.

Mangrove associated plants such as *Hoya burm*anica (kha-mon or son-pa-lon),*Phoenix paludo*sa (thin-paung), *Pluchea* indica (kharu), *Clerrodendrum sp.* (pin-lae-kyaung-pann) and *Sesbania paludo*sa (nyan) were also found.

At least three species of grass including *Cyperus sp.* (wet-lar-myat), *Imperata cylindrical* (thet-kai-myat) and the unidentified grass myet-karr were observed.

This small stretch of mangrove and associated plants around the creek will probably remain intact as this area is a void area or undesignated area sandwiched between plot No. 13 and No. 14 of Myawaddy Trading Co. Ltd; formerly known as U Paing Holding Co. Ltd.

Discussion and conclusion

The Yangon River is, no doubt, the most polluted river in Myanmar. Virtually all the sewages, domestic wastes and industrial wastes of the mega-city (with a population of about 6 millions) in one way or another find their ways into the river. The river is also extremely turbid; in every plankton sample the quantity of minute detritus, both inorganic and organic, greatly exceeds the biomass of plankton. When microscopically examining preserved plankton sample one can easily detect colonies of bacterial many of them coliform type and are, no doubt, pathogenic. There are also tremendous amount of debris of all kinds in the water, especially discarded plastic (polythene) bags, which cannot be seen in the very turbid water. These plastic bags are a great nuisance for the fishermen due to their entanglement of the drift nets or the clogging of the stationary bag nets. Often the fishermen cannot cope with this problem and have to hire youngsters for removing the discarded bags after spreading the fishing nets on shore. The aquatic team had sometimes witnessed the jamming of the propeller of the boat by these discarded bags.

Although the Yangon river is extremely polluted the hardy species of fish (eurythermal and euryhaline brackish water species) still thrive in the river, feeding mainly on organic detritus and to a lesser extent plankton.

Although fish no longer abound as they used to be three or two decades ago they are still relatively plentiful during certain period of the year, for instance, during certain pre monsoon and post monsoon months. There was a considerable decline of fish population during the last decade and fisher folks are complaining of this decline since it is no longer feasible to fish during all months of the year. Theoretical environmentalists will point out that the decline of fish was due to severe water pollution. This is true to a certain extent. The main factor, however, that cause the sharp decline of fish is overfishing, over-exploitation and increase effort of fishing.

As mentioned above these hardy fish still thrive in the severely polluted Yangon river. But it is very sure that these fish can no longer inhabit the river if major spillage or leakage of oil occurs. These hardy fish can with stand other types of pollution but not severe oil pollution. Many precedents of major spillages of oil causing devastating effect on fisheries have happened in some parts of the world during the last decade. Puma Energy company should be awared of this fact and pay serious attention not to cause any major spillage or leakage of oil. The company should strictly adhere to the environment laws, rules and regulations which are now in the advanced stage of formulation at the Pyithu Hlutaw, and will come to effect soon. It is also learnt that Petroleum Rules will be also formulated at the Hlutaw soon. The company should, above all, strictly follow this Petroleum Rules when it becomes effective in the very near future.

We would like to urge Puma Energy Co. and all other companies situated along the east bank of the river not to add more burden to the already extremely polluted river and exacerbate the already serious issue. As all these companies have the financial capabilities they should collectively find means and ways of alleviating the serve pollution of the Yangon River. This will surely have a long term benefits for the companies as well as the local people of the region.

Overzealous or radicalized environmentalists will be, no doubt, against all this port complex project. But one should not be out of touch with the reality of the country. Myanmar is still a least developed country (L.D.C) and its infrastructure is still in a very backward stage. We still have a long way to go when it comes to infrastructure development. An environmentalist should try to see and understand the harsh reality of the country and should be careful not to hinder or jeopardize the development of the infrastructure of the country by his words or deeds. With national development always in mind we will not be against any developmental project as long as it does not destroy the environment on a large or relatively large scale.

As Puma Energy Co. will involve only in the storage and whole sale distribution of fuel oil there will be no factory on the site spewing out billows and billows of dark smoke. We also do not envisage the dumping of large quantity of industrial wastes into the river since the site is only an oil storage site, but not a production factory. But this does not necessary mean that oil storage tanks, its facilities and jetty are not sources of pollution. There can be certain leakage or spillage if utmost care is not taken during the shipment or handling of the oil cargo. And such as a spillage or leakage will have a very detrimental effect on the aquatic environmental. Even if the spillage occurs on ground this will eventually find its way into the river.

Major leakage or spillage of oil should be avoided at all cost. If there is any accidental leakage or spillage the company must take all responsibilities for the damage done, including compensation of all kinds and effective rehabilitation of the damaged ecosystem.

The chance for major spillage or leakage by oil cargo ship or oil tanker in the river due to mishap, such as ship run aground, is very remote indeed. The Yangon river is a navigationally well charted river and whenever a foreign vessel enter the river it has to follow the route of the small pilot vessel navigated by an experience Burmese pilot. There was of course no mishap happening in the river within memories, that is, in the last 50 years or so. And the chance of terrorists attack on the oil storage facilities is also remote since the area has no security issue as it is close to Yangon city proper. But one should never be complacent with security situation. When all oil storage tanks and facilities of all companies are in running condition there can be certain elements of terrorists who might be tempted to blow up the facilities. This can cause huge loss for the companies as well as catastrophic effect on the aquatic environment. And one should remember that fuel oil tanks are very vulnerable to terrorists attack due to their high flammability. This is not, of course, a lecture given by ENCA to the company but the later should foresee this danger and take preventive measure for the long term benefits of the company and the riverine environment.

Table. 1. Showing positions of stations, date, time etc and collection of data

Stations		St.1		St.2		St.3	
G.P.S position		N 16 40'46.0" E 96 14' 09.5"		N 16 40' 08.9" E 96 14' 44.2"		N 19 39' 14.9" E 96 15' 38.6"	
Time:		11:00am	16:30	11:30	06:00	12:30	
date:		12.7.13	12.7.13	13.7.13	14.7.13	14.7.13	
Tide condition		Low tide	High tide	L.T	H.T	L.T	H.T
Weather		Totally cloudy	Partly cloudy	Partly cloudy	Cloudy drizzle	Totally cloudy	Totally cloudy
Sounding		3.5m	10m	3.5	10	4	11
Current velocity		10m/25sec	10m/13sec	10m/20sec	10m/15sec	Still water	10m/15sec
Air temperature		28.5C	26.5C	27	25	26	25
Water temperature		28C	28.5C	29	28	28.5	28
Soil temperature		28C		25		28	
Salinity		0 ppt	0		0	0	0
pH		8.7	8.8	8.8	8.1	8.7	7.9
D.O		6.5ppm	5.5ppm	7ppm	7ppm	8	7.5
Transparency		0m	0	0	0	0	0
Substrate		Sandy mud		Soft mud		Soft mud	
Bank width		30m		25m		70m	
Bank height		3m		5m		5m	
Gradient		30degree		35		30	
Mode of plankton collection	Phyto	hor	hor	obl	hor	vert	hor
	Zoo	obl	hor	obl	hor	obl	hor

Note. Due to unfavorable weather condition in the afternoon of 13.7.13 the trip has to be rescheduled to coincide with tides the following day

Table. 2. List of plankton from the adjacent water of Puma Energy Co.Ltd property (Genera are listed in phylogenetic order) L.T=Low tide H.T=High tide

sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
	(A) PHYTOPLANKTON						
	Baccillariophyta (Diatoms						
1	*Hyalodiscus stelliger*	*			*	*	*
2	*Melosira grannulatas*	*	*	*	*	*	*
3	*M. islandica*	*	*		*	*	*
4	*M. italic*	*	*		*		*
5	*Thalassiosira bramaputrae*			*		*	
6	*Coscinodiscus asteromphalus*	*	*	*	*	*	*
7	*C. centralis*			*		*	*
8	*C. janesianus*		*	*	*	*	*
9	*C. lacustris*	*	*	*	*	*	*
10	*C. lineatus*		*	*	*	*	*
11	*C. oculus iridis*	*	*	*	*	*	*
12	*C. radiatus*	*	*	*	*	*	*
13	*Cyclotella comta*	*		*	*	*	*
14	*C. striata*	*	*		*	*	*
15	*Gossleriella sp.*		*		*		*

sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
16	*Biddulphia sinensis [Odontella sinensis*	*					
17	*Ditylum sol.*	*					
18	*Syrigidium americanum*	*			*		
19	*Triceratium sp.*	*		*		*	*
20	*Fragillaria capucina*	*	*	*	*	*	*
21	*F. crotonensis*			*		*	
22	*Diatoma elongata*		*	*	*	*	*
23	*Climacosphenia moniligera*	*	*	*		*	*
24	*Synedra acus*	*	*	*	*	*	*
25	*S. affinis*		*		*	*	*
26	*S. tabulata*	*	*	*	*	*	*
27	*S. ulna*	*	*	*	*	*	*
28	*Navicula elegans*					*	
29	*N.minuta*			*			
30	*Navicula sp.*				*		
31	*Pleurosigma angulatum*		*				
32	*P. aestuari*	*	*				*
33	*Pleurosigma sp.*		*				*
34	*Gyrosigma peisonis*	*					*
35	*G. sphincerii*				*		*
36	*G. strigile*		*		*		*
37	*Gomphonema gracilis*	*					
38	*Nitzschia brebesoni*	*	*	*	*	*	
39	*N. closterium*					*	*
40	*N. gracilis*		*	*		*	*
41	*N. lanceolata*					*	*
42	*N. longissima*	*	*		*		*
43	*N. longissima var reversa*		*			*	*
44	*N. sigma*	*	*	*	*	*	*
45	*N. sigma var. intercedens*	*	*	*	*	*	*
46	*N. sigma var. intermedium*	*	*	*	*	*	*
47	*N. scalaris*	*	*	*	*	*	*
48	*N. spectabilis*	*	*		*	*	*
49	*Surinella*	*					
50	*S. caproni*	*		*			*
51	*S. elegans*	*	*		*		
52	*S. norvegica*	*					*
53	*S. ovate*					*	
54	*S. robusta*	*	*	*	*	*	*
55	*S. robusta var. splendida*		*				*
56	*S. tenera*	*				*	*
57	*Campylodiscus herbinecus*						*
	Cynophyta (Blue green algae)						
58	*Microcystis aeruginosa*	*	*	*	*	*	
59	*M. amethystina*	*		*			

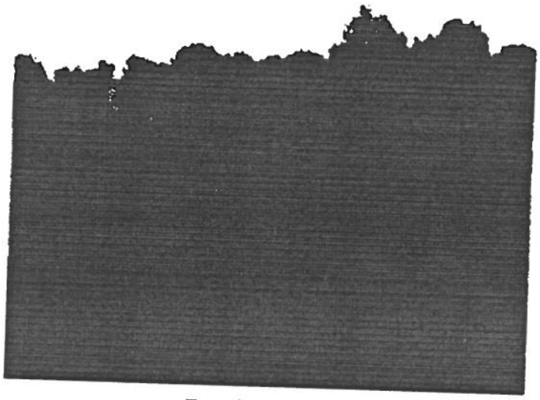
sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
60	*M. flosaquae*	*	*	*	*	*	*
61	*M. marginata*	*		*	*	*	
62	*Coeloaphaerum kutzingianum*	*			*		
63	*Oscillaoria limnetica*		*			*	
64	*O. prinups*		*		*		
65	*Lyngbya subconfervoides*	*					
66	*Spirulina princeps*		*				
	Chlorophyta (Green algae)						
67	*Volvox aureus*					*	
68	*Eudorina elegans*		*				*
69	*E. Unicocca*		*		*		*
70	*Pediastrum boryanum*		*				
71	*P. duplex*		*				*
72	*Ankistrodesmus falcatus*						*
73	*Ulothrix aequalis*	*					*
74	*U. zonata*		*		*	*	*
75	*Mougeotia japonica*				*	*	*
76	*M. scalaris*	*	*		*	*	*
77	*M.viridis*			*			*
78	*Mougeotopsis calispora*						*
79	*Mougeotopsis sp.*				*		*
80	*Spirogyra ahmedabadensis*			*	*	*	*
81	*S.flavitilis*		*		*	*	
82	*S. ionia*	*				*	*
83	*S. protecta*		*		*		*
84	*S. setiformis*	*	*		*	*	*
85	*Spirogyra sp.*		*		*		
86	*Sirogonium strictum*	*	*				*
87	*Pleurotaenium trabacula*						*
88	*Closterium acerosum*						*
89	*C. dianae*						*
90	*C. ehrenbergi*	*		*			
91	*C. gracile*				*		
92	*C. leibleinii*				*		
93	*Micrasterias foliacea*	*					
94	*M. mahabuleschwarensis var surculifera*						*
95	*Xanthidium antilopaeum*						*
96	*X. bengalianum*						*
97	*Octacanhium convergens [Arthrodesmus convergens]*						*
98	*Staurastrum gracile*	*					
99	*S. leptocladum*	*					*
100	*S. tohopekaligense*				*		
	(B) ZOOPLANKTON						
	Protozoa						
101	*Microgromia socialis*	*	*		*	*	

sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
102	*Leiberkuhnia wagneri*			*	*	*	
103	*Difflugia corona*				*		*
104	*D. globulosa*				*		
105	*D. limnetica*				*	*	*
106	*Centropyxis acureata*	*	*		*		*
107	*C. ecornis*	*			*	*	*
108	*Arulla discoides*	*		*	*		*
109	*A. vulgaris*	*			*	*	*
110	*Paramesium sp.*			*			
111	*Globorotalia sp.*						*
112	Foraminifera: Globigerinidae (Unidentified)				*		
113	*Hexalonche sp.*	*					
114	*Codonella aspera*		*		*		*
115	*Tintinnopsis beroidea*		*		*	*	
116	*T. brevicolis*					*	*
117	*T. gracilis*		*		*		*
118	*T. lobiacoi*		*				*
119	*Cyttarocylis cassis*		*				*
120	*Petalotricha ampulla*	*			*		*
121	*Parundella pellucida*	*					
122	*Uroleptus sp.*				*		
123	*Unidentified ciliaate (Oxytrichidae)*				*		
	Rotifera						
124	*Asplanchna priodonta*					*	*
125	*Brachionus calyciflorus var amphiuros*					*	
126	*B. quadridentata*					*	
127	*Brachionus sp.*					*	
128	*Diplois sp.*	*	*				
129	*Keratella cochlearis*						*
130	*K. valga var. monostrosa*						*
131	*K. valga var. tropica*	*	*		*		*
132	*Colurella sp.*			*			
133	*Filinia longiseta*		*				*
134	*F.terminalis*						*
	Crustacea						
135	*Diaphanosoma brachyura*					*	
136	*Ceriodaphnia sp.*	*	*		*		*
137	*Moina dubia*	*			*		*
138	*Moina sp.*				*		*
139	*Bosmina longirostris*	*					
140	*Chydorus barroisi*	*					*
141	*Cytheridea punctilata*	*					
142	*Cytheridea sp.*					*	
143	Unidentified ostracod				*		

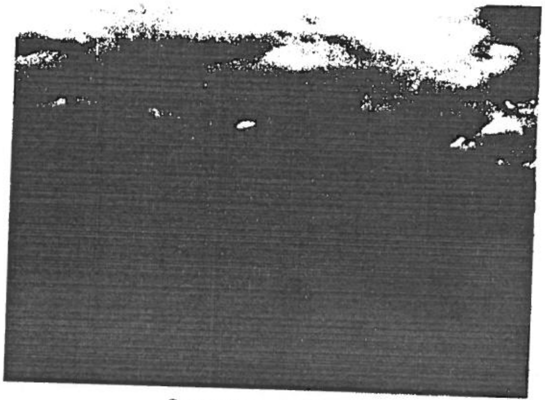
sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
144	*Paracalanus crassirostris*		*		*		*
145	*Centropages alcocki*		*				*
146	*Diaptomus regardi*			*		*	*
147	*Pseudodiaptomus sericaudatus*		*		*	*	*
148	*Pseudodiaptomus sp.*		*		*		
149	*Acartia southwelli*	*	*				
150	*A. spinicauda*				*		*
151	*Acartiella kempi*	*	*	*	*	*	*
152	*A. sewelli*	*	*	*	*	*	*
153	*Acartiella sp.*				*		*
154	*Tortanus barbatus*		*		*		*
155	*Oithona brevicornis*	*	*	*	*	*	*
156	*Mesocyclops sp.*	*	*	*	*	*	*
157	*Eucyclops sp.*	*	*	*	*	*	*
158	*Sphirella sp.*	*	*				
159	Unidentified harpacticoid		*				
160	Gammarid amphipod (unidentified)				*	*	
161	Amphipod: sciniidae (unidentified)	*	*	*	*	*	*
162	Amphipod: vibiliidae (unidentified)	*	*			*	*
163	Isopod (Idotiidae) (unidentified)		*				*
164	*Rhopalopthalmus kempi*						*
165	*Mesopodopsis orientalis*	*	*		*	*	*
166	*Acanthomysis pelagica*					*	
167	*Acetes indicus*		*		*		*
	MEROPLANKTON						
1	larvae of nematode	*	*	*			*
2	larvae of polychaete including:						
	frochophore of Hesionidae		*			*	
	frochophore of Capitellidae		*				
	frochophore of Nereidae			*		*	
	Nectochaete of Hesionidae		*			*	
3	nauplius and metanauplius						
	calanoid copepod	*	*	*	*	*	*
	cyclopoid copepod		*	*	*	*	*
	harpacticoid copepod	*		*		*	*
4	Copepodites of:						
	calanoid copepod	*	*		*		*
	cyclopoid copepod	*	*	*	*	*	
	harpacticoid copepod	*			*		*
	planktonic eggs of copepods	*	*	*	*	*	*
5	larvae of cryptonisid isopod		*				
6	larvae of caridean prawns (various)	*	*	*	*	*	*
7	nauplius of penaeid		*		*		
8	larvae of penaeid		*		*		*
9	juveniles of Acetes		*		*		*

sr	List of species	Station.1		Station.2		Station.3	
		L.T	H.T	L.T	H.T	L.T	H.T
10	zoea larvae of brachyura (crabs)					*	*
11	megalopa larvae of brachyura (crabs)		*				*
12	planktonic eggs of shrimp and prawns	*	*	*	*	*	*
13	larvae of insect (Diptera), Corethra sp.					*	
14	larvae of insect (Odonata)						*
15	veliger larvae of bivalve		*		*	*	*
16	veliger larvae of gastropod		*	*		*	*
17	planktonic fish larvae (various)	*	*	*		*	*

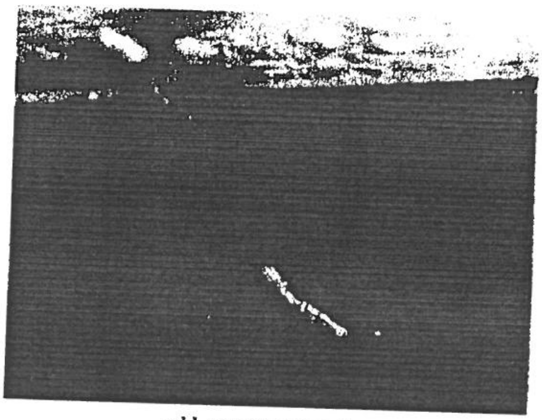
Note. a) A total of 97 species and 5 varieties of phytoplankton
b) 67species and 1 variety of zooplankton
c) 25 kinds of meroplanktonic eggs and larvae



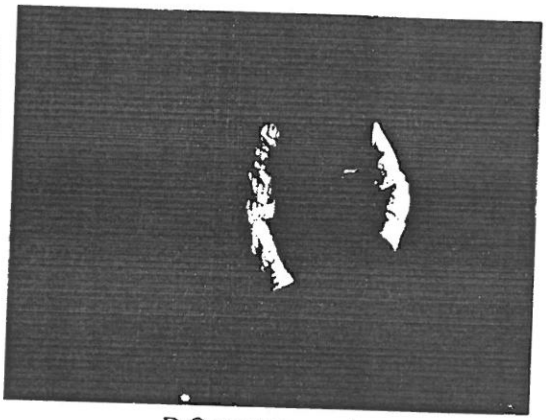
Benthos study



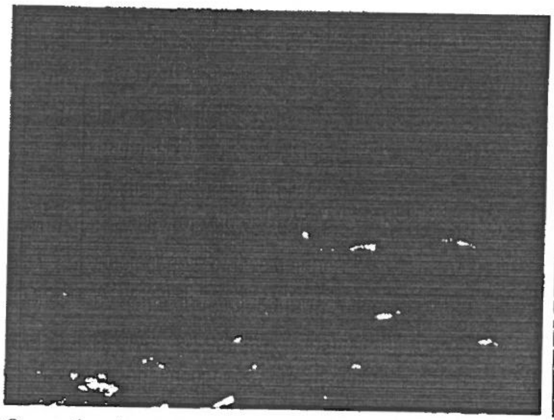
Operating drift net



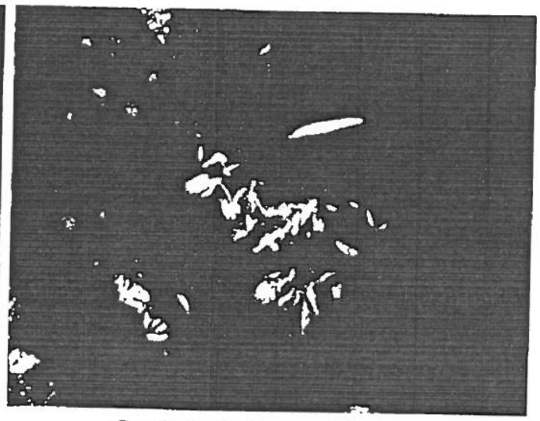
pH measurement



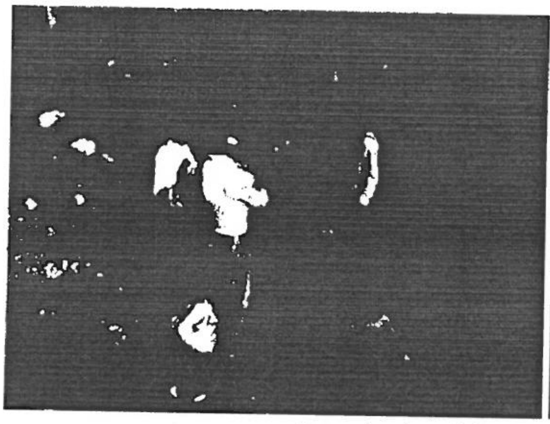
D.O measurement

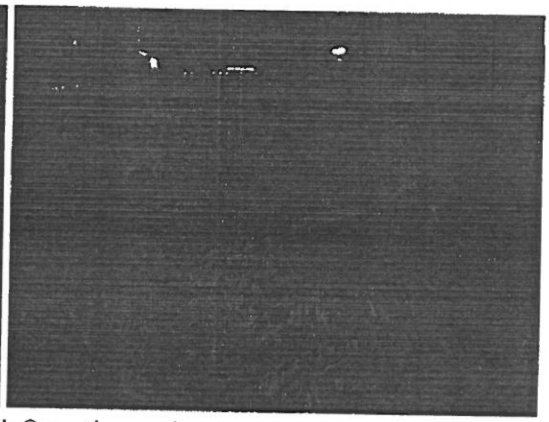


Operating bag net

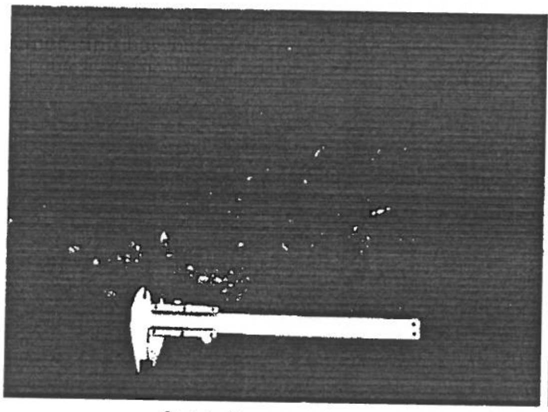


Catch made from push net

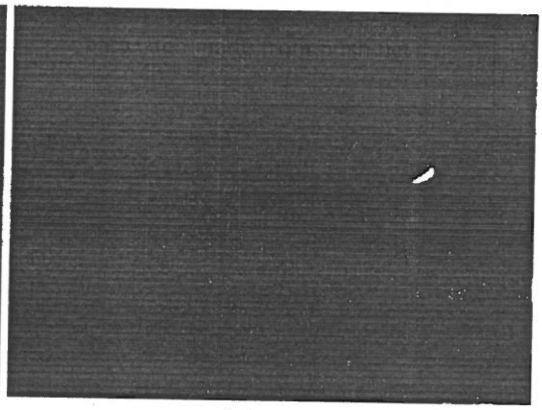




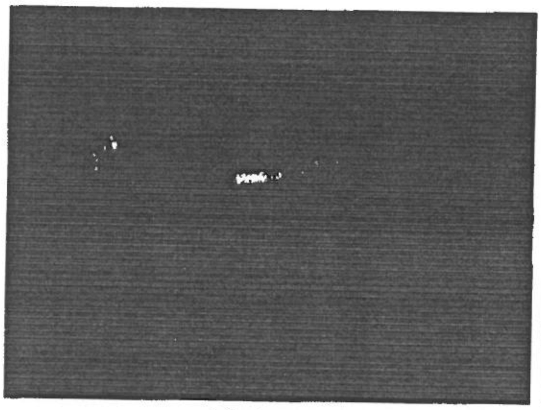
Interviewing fisher fork Operating push net



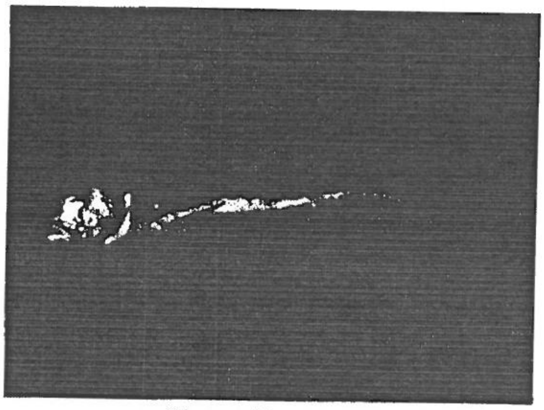
Catch from cast net



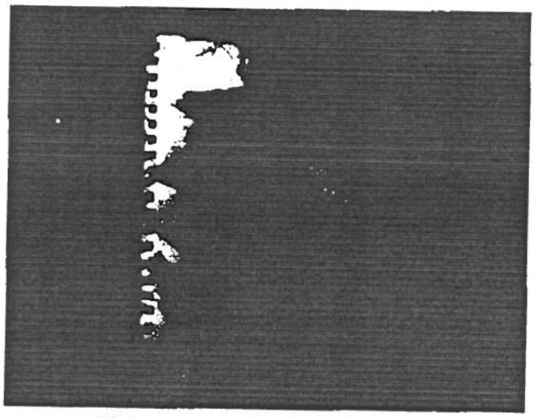
Arius sp.



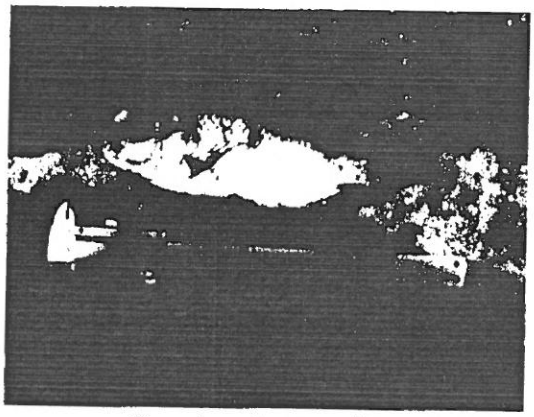
Johnius sp.



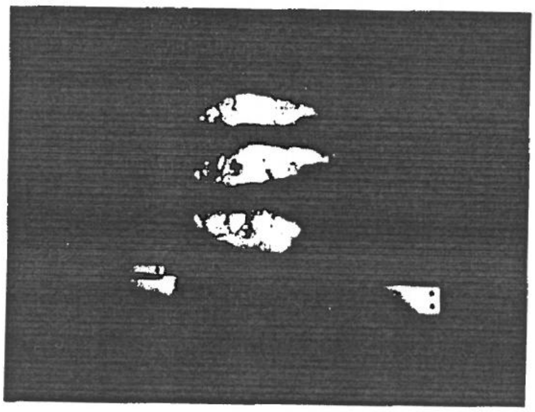
Chrysochir aureus



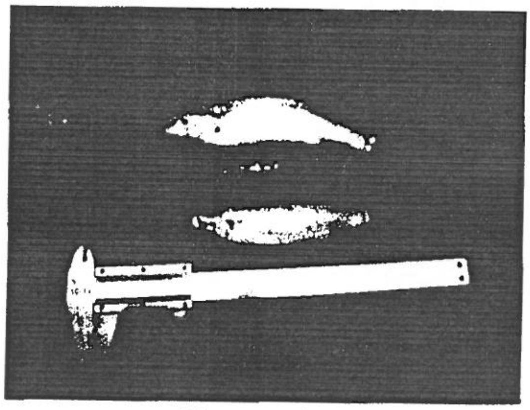
Fish prawn crabs from bag net



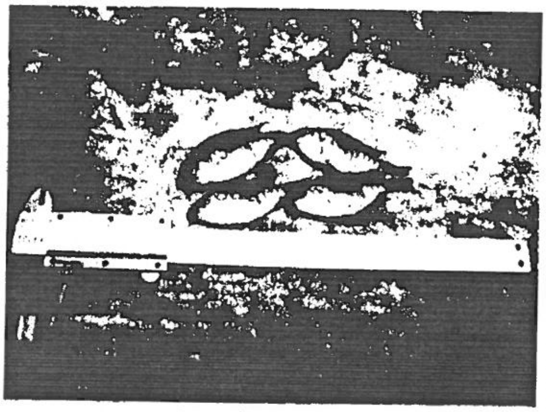
Oreochromis mosambica



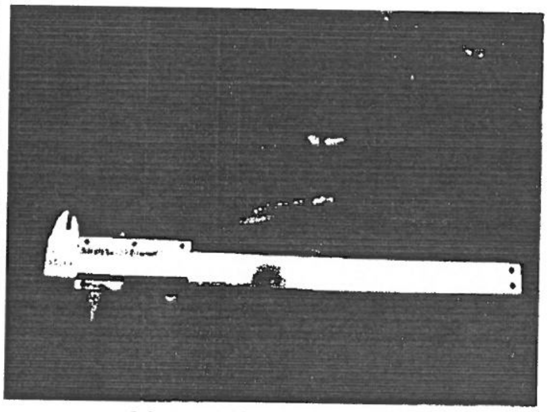
Lates calcarifer



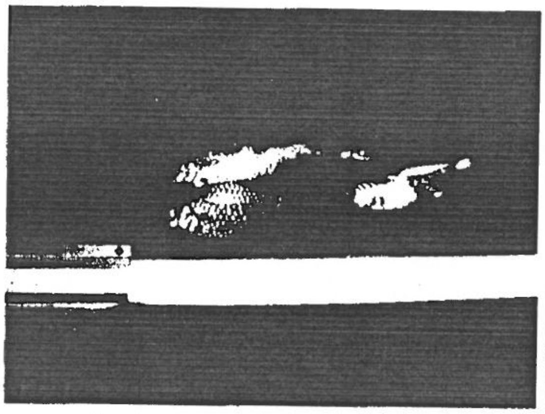
Rhinomugil sp.



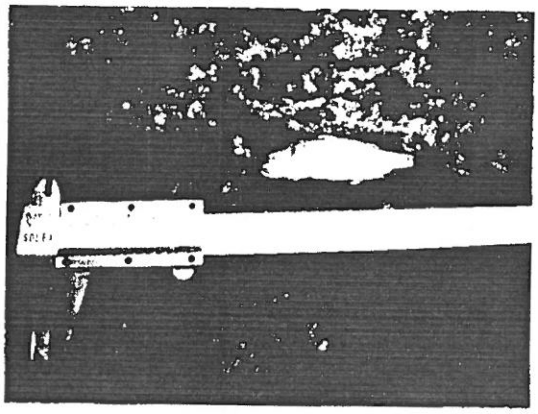
Juvenile telapia



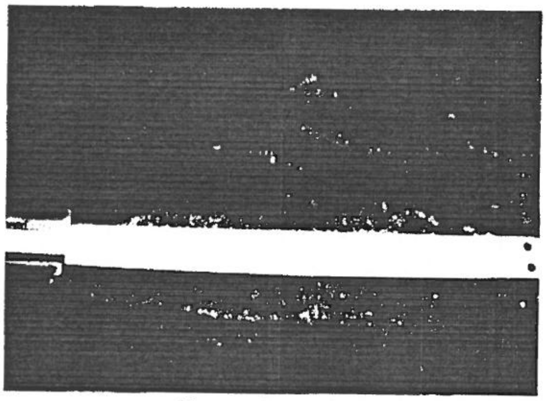
Mastacembelus armatus



Barbus sp and *Ambassis baculus*



Juvenile *lutjanus*



Clarius batrachus